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B.1.1 Concept and project objective(s)

1.1 Concept and objectives

Climate change is expected to impact extreme weather, including changes in the frequency of floods, heatwaves and droughts in many parts of the world (Meehl et al, 2007, Seneviratne et al, 2012). Globally there is evidence that an increase in the frequency of warm temperature extremes and a decrease in the frequency of cold temperature extremes have already been observed (Alexander, et al, 2006, Trenberth et al, 2007, Seneviratne et al, 2012). Mounting evidence from across the climate system, including changes in temperatures, precipitation sea ice, snow cover, and oceanic temperature and salinity shows that there is an increasingly remote possibility that climate change is dominated by natural rather than anthropogenic factors (Stott et al, 2010). Regardless of the future trajectory of greenhouse gas emissions, societies already need to adapt to a changing climate, and, given the lags in the climate system's response to changing forcing, are likely to have to adapt to further changes in climate which are locked in and unavoidable.

There is therefore a clear need to adapt effectively to climate change, particularly in Europe, where recent heatwaves (Schär et al., 2004; Beniston, 2004; Barriopedro et al, 2011, Dole et al., 2011), floods (Pall et al. 2011; Christensen and Christensen, 2004) and droughts (Feyen and Dankers, 2009) have demonstrated the vulnerability of European citizens to extreme weather. However, scientifically robust information about the extent to which recent extreme weather can be linked to climate change is often lacking (Schiermeier, 2011) and there is still substantial uncertainty in past trends in droughts and floods, due to methodological issues and to the lack of reliability of relevant observations (Seneviratne et al. 2012, Sheffield et al. 2012). This is important, because if weather-related risks and their possible changes with human influence on climate are not well understood, societies could be adapting poorly to ill conceived perceptions of their vulnerability to climate-related changes in extreme weather.

There is now an excellent opportunity to remedy this situation, because the science of climate attribution is beginning to address the challenge of quantifying the link between climate change and recent extreme weather events (Peterson et al, 2012). It has already been demonstrated that it is possible to estimate attributable changes in climate risks, with studies showing that human influence very likely more than doubled the chances of the European heatwave of 2003 (Stott et al, 2004), increased the risk of floods occurring in England and Wales in Autumn 2000 (Pall et al, 2011) and contributed to an enhanced risk of the Texas heatwave in 2011 (Rupp et al, 2011). But such studies are still thin on the ground, are research based and provide at times apparently contradictory conclusions, as was the case with analyses of the Russian heatwave of 2010 (Dole et al, 2011; Rahmstorf et al, 2011; Otto et al, 2012).

Our vision is to develop a quasi-operational attribution system, well calibrated on a set of test cases for European extreme weather, that will provide to targeted groups of users, well verified, well understood assessments on the extent to which certain weather-related risks have changed due to human influences on climate. The system will include an ensemble of diagnostics that will help better understand the processes driving the events and the reliability of the methodologies used.

This will improve the ability of European businesses, regional and national authorities, and citizens to make effective decisions in climate- and weather-sensitive sectors. It forms a crucial component of the pre-operational capacities in the climate change context of Copernicus, and should enable the growth of a downstream service sector. It provides an opportunity for Europe to lead the way in developing systems to deliver attribution products. Partners in this consortium are founding members of the international Attribution of Climate-related Events group (ACE), an informal network of scientists recently formed to advance the science needed and to engage with stakeholder groups (Stott et al, WCRP paper). Consequently, while EUCLEIA will concentrate on European weather events, it will draw on expertise and modelling results from collaborative groups from the US, Japan, Australia, and New Zealand, part of a widening network of scientists who are engaged in developing attribution assessments for their region (see letters of support in Appendix 3). An important new initiative, launched in 2012

and published annually in the Bulletin of the American Meteorological Society, brings together such attribution assessments of the previous year's extreme weather and climate event (Peterson et al, 2012). It is co-edited by the EUCLEIA coordinator, and, alongside more user-targeted fora, and the standard peer-reviewed literature, we see this high profile peer-reviewed annual report as a major opportunity for us to demonstrate the impact and value of the attribution products developed under EUCLEIA (see also letter of support in Appendix 3 from Dr Thomas Peterson, lead author and editor of the *Bulletin of the American Meteorological Society* paper Explaining Extreme Events of [the previous year] from a Climate Perspective.)

In ancient Greek mythology, Eucleia was the ancient Greek female spirit of glory and good repute. As such she stands as a fitting representative of our endeavour, to enable Europe to lead the world in the development of attribution products that, because of the careful and thorough nature of their development as described in this project, are of exceptionally good repute, providing information on which commercial and policy users can rely for their weather sensitive decision making.

Objectives

EUCLEIA has five top level objectives each of which is associated with project milestones and deliverables as follows, and which map directly onto the five Work Packages.

1) Derive the requirements that targeted user groups (including regional stakeholders, re-insurance companies, general public/media) have from attribution products and demonstrate the value to these users of the attribution products developed under EUCLEIA (WP4);
2) Develop experimental designs and clear ways of framing attribution studies in such a way that attribution products provide a fair reflection of current evidence on attributable risk. (WP5);
3) Develop the methodology for representing the level of confidence in attribution results so that attribution products can be trusted to inform decision making (WP6);
4) Demonstrate the utility of the attribution system on a set of test cases of European weather extremes (WP7);
5) Produce traceable and consistent attribution assessments on European climate and weather extremes on a range of timescales; on a fast-track basis in the immediate aftermath of extreme events, on a seasonal basis to our stakeholder groups, and annually to the BAMS attribution supplement (WP8).

These objectives relate to the topics addressed by the call as follows :

- By producing evidence for whether the risk of similar events to those that have occurred in Europe has increased, decreased or remained stable (WP7 for test cases, WP8 for ongoing evaluation in near-real time);
- By studying a number of historical cases, related to flooding, droughts and storm surge events (WP7);
- By proposing exhaustive diagnostics of driving climate processes of events under study in order to properly evaluate the attribution system's ability to simulate them and deliver user-relevant products together with appropriate reliability assessments (WP6);
- By identifying those types of events where the science is too uncertain and observations insufficient to make a robust assessment of attributable risk (WP6,7,8);
- By delivering a quasi-operational system that contributes significantly to the pre-operational capacities in the climate context of Copernicus by providing regularly updated, reliably calibrated information on the extent to which extreme weather and climate events are attributable to natural and anthropogenic factors (WP8);
- By facilitating the development of climate adaptation strategies through working with stakeholder groups representing both commercial activities (insurance industry) and policy initiatives (regional managers, public) (WP4).

A key feature of the proposed approach is that it will start from stakeholder needs in developing and delivering attribution products. It will benefit considerably from international efforts to develop the underpinning science and to engage stakeholders. Many of the partners in this consortium are active participants in the long running International ad-hoc Detection and Attribution group (IDAG), which has over many years developed the science of

detection and attribution and produced review papers summarising the progress in the field (IDAG, 2005; Stott et al, 2010) and which strongly supports EUCLEIA (see letter of support in Appendix 3). The Attribution of Climate-related Events (ACE) group was formed at the IDAG meeting of 2009. It held its first meeting of scientists and stakeholders in August, 2010 in Broomfield, Colorado, USA and its second meeting in Oxford, UK in September, 2012 and it is envisaged that future meetings will be held on an annual basis and will involve a substantial contribution from EUCLEIA (see also letters of support from ACE collaborators in Appendix 3). Crucially also, the project has close links with the development of seasonal climate forecasting as represented by the EUPORIAS and SPECS consortia and through the involvement of groups at the Met Office and EC-Earth. In addition, it also has close links to the EU-FP7 project DROUGHT-RSPI, which develops hydrological forecasting methodologies for droughts. The project will also benefit from the experience and data acquired from recent new Climate Model Intercomparison Project (CMIP5) simulations, and from several recently developed international in situ and remote sensing observation data sets. Seasonal forecasting is closely tied to the development of attribution systems, both in the aspect of model verification, a crucial aspect of both activities, and in the aspect of putting extreme weather into the long term context of climate variability and change. Our attribution system will be based on the model used for the Met Office seasonal forecasting, maximising the mutual benefit to both attribution and seasonal forecasting endeavours.

How will these objectives be met?

Central to the success of the project is the role of the **stakeholders** who will provide the starting point from a user/decision maker's perspective and who will be engaged closely throughout the development of attribution products. WP3 will ensure that meaningful dialogue is developed and maintained throughout the project to ensure that stakeholders identified in WP4 can actively inform the research process, as well as feeling engaged with the science. The foundation of this engagement process will be face-to-face workshops where stakeholders and researchers can openly discuss key aspects of methodology and the option for what a 'product' could be. The first workshop, at the start of the project, will provide an opportunity to establish key principles, ideas and working practice, whilst a mid-point and end of project workshop will allow for stakeholders and researchers to monitor, review and evaluate. A range of mechanisms including a website, project eNews and podcasts will maintain communications channels informing stakeholders of project developments. These channels will also be critical in maintaining the interest and engagement of users identified in WP4. The website will act as a central point for users to access key information, including project outputs/data, during the project. These outputs will be written for both technical and non-technical audiences and in a range of languages, whilst discussion forums allow the stakeholders to directly question each other and the researchers regarding the science.

WP4 led by HZG will focus on two case studies concerning regional publics and stakeholders in the Ile de France and the German Baltic Sea coast regions in order to provide in depth analyses of German and French speaking stakeholders concerned with the effects of heatwaves and droughts in central France and storm surges along the Baltic coast. Selecting case studies in this way will provide the focus needed to identify specific ways in which the attribution products developed can better meet user needs. At the onset of the project, a short series of in-depth interviews will be conducted with selected stakeholders to gain insight into the needs and wishes of stakeholders. This will address such issues as preferred means of communication, what should be included in communications, what extreme events are of particular interest, etc. In short, this will be an exploratory component of the work package. Parallel to these interviews a user group workshop will focus on the similar questions. Subsequently, the information gained from the interviews and from the workshop will be incorporated into a larger series of survey questionnaires. In the interviews, the workshop and the data collection with survey questionnaires, user groups will be representative of: 1. The general public; 2. Sector specific regional stakeholders, 3. Scientists involved in climate change in the German Baltic region, and; 4. A single study of commercial interests, namely the insurance industry. This is the data collection phase of the work package. The final analysis will consist of the statistical summarisation of the data in a format in line with the goals of the project. A focus on the insurance industry is important, as this is a key stakeholder concerned with robust characterisation of weather and climate-related risks. Following on from discussions at the ACE meeting in Oxford in September, 2012, which involved representatives of the insurance industry, we have identified suitable stakeholders to represent their interests and to help guide the development of attribution products to meet needs of key sectors (see supporting letters in Appendix 3). This will meet objective 1.

WP5, led by the University of Oxford, will explore the impact of methodological choices and framing of the attribution problem to ensure that attribution products provide a **fair reflection of the current evidence** on attributable risk of extreme weather and climate events. This WP will consider both statistical and dynamical approaches. The former will allow a fast track response in the days immediately following an extreme weather or climate event and statistical methodologies for comparing recent climate events with past events will be developed in this WP. The latter will be based on a core suite of HadGEM3-A simulations, the model configuration maintained to be using the same atmospheric model as the Met Office seasonal forecasting system). The basic design involves comparing simulations of models with observed sea surface temperatures (SSTs), with simulations with alternative SSTs representing possible alternative realities in which particular anthropogenic or natural drivers are absent. From these simulations, estimates of the changed risk of particular events can be calculated. By taking advantage of distributed computing, WP5 will explore attribution methods with a variety of models to come up with an optimal method for use of the state of the art models in the more operational environments.The sensitivity of attribution results to a range of framing issues such as, experimental design, ensemble size, model resolution, and the representation of ocean-atmosphere interactions will be explored. The findings will inform the setting up of the near-real time attribution system developed by WP8. The effects of model structure will be investigated by comparing results from the core model, HadGEM3-A model with the EC-Earth model. The consistency of results based on dynamical and statistical approaches will be assessed. A detailed comparison of results from atmosphere only models and coupled models (CMIP5) will be carried out. As a result of these methodological developments and sensitivity studies this WP will build a robust basis for the construction of attribution products that fairly represent current weather and climate risks. This will meet objective 2.

The sixth work package, WP6, led by CNRS, is the centre piece and fulcrum of EUCLEIA. It develops key ingredients on which **trust in attribution products** will be based. Trust relies on users being able to understand the extent to which attribution products are based on reliable and robust assessments of weather and climate risk. This in its turn depends on an objective analysis of the models being used to generate attribution products and their ability to simulate the development of the various classes of extreme weather and climate events being assessed. To do this WP6 will develop a comprehensive set of diagnostics that characterise the key physical processes involved in the development of the events, will investigate how model biases impact the level of confidence in attribution results and will develop quantitative measures of the reliability of the dynamical attribution system based on techniques used in seasonal forecast verification. WP6 will develop rules to produce confidence levels for assessments, based on calibrated language, which will enable a user to understand the extent to which they should place trust in attribution products. This will meet objective 3.

WP7, led by KNMI, will demonstrate the **utility of the attribution system** by carrying out a set of attribution assessments of chosen **test cases** to include examples from the recent past of heat waves, cold spells, floods, droughts, and storm surges. The diagnostics developed in WP6 will be applied within both fast track statistically based methods and within the HadGEM3-A based dynamical attribution system. Lessons learned will be incorporated into the further development in WP8 of the quasi-operational attribution system. By considering specific case studies of extreme weather and climate events observed in recent years this WP will demonstrate the utility of a quasi-operational attribution system. This will meet objective 4.

WP8 led by the UK Met Office will develop **a quasi-operational attribution system** and will apply it to provide fast-track assessments in the week following weather and climate events, assessments at the end of each season based on the HadGEM3-A attribution system, and assessments of the main extreme events of the previous year delivered to the annual BAMS report putting such events into the context of climate variability and change. WP8 will be informed by the user perspective investigated by WP4, will use tools developed in WP5, will apply evaluation methodologies from WP6 to quantify the reliability of the results, and will apply lessons learned from the case studies in WP7. The developments made in EUCLEIA will enable the currently long timescales (typically of the order of several years) needed to provide scientifically robust and reliable information after an event occurs to be significantly shortened. As a result, WP8 will provide a (pre-) operational capacity to deliver attribution products on a regular basis. This will meet objective 5.

B.1.2 Progress beyond the state of the art

B.1.2.1 State of the art

While research into the causes of global and regional trends in temperature and other climate variables is well advanced, as represented by the increasing degree of confidence in attributing warming since the mid 20th century to human influence in successive IPCC reports (Santer et al, 1996; Mitchell et al, 2001; Hegerl et al, 2007), the science of attribution of individual extreme weather events is relatively new, as highlighted in the recent IPCC SREX report (Seneviratne et al. 2012). While it isn't possible to say definitively that an individual weather event was or was not due to climate change (because it is hard to conceive of any particular weather event that would have been impossible today if human activities had not altered climate) it is possible to calculate the extent to which human and natural influences on climate have altered the odds of a particular type of weather event occurring (Allen, 2003). The utility of this approach was demonstrated in a study of the European heatwave of 2003, a devastatingly hot summer that is estimated to have led to between 22,000 and 35,000 heat related deaths across Europe and from the associated drought to around US$12.4 billion of uninsured crop losses and extensive damage from forest fires (Schar et al, 2004). This first attribution study of an individual climate event concluded that it is very likely (confidence level > 90%) that human influence had at least doubled the risk of extreme summer temperatures throughout Europe of the magnitude of 2003 (Stott et al, 2004). This was based on the principle of analysing climate model simulations including both anthropogenic and natural forcings to represent the conditions of the world we live in and alternative climate model simulations including only natural factors, to represent the world we might have had, had there not been human influence on the climate. While further studies have extended this approach for temperature-related events in other regions (Christidis et al., 2012a; Christidis et al., 2012b) applying a similar approach to other variables such as precipitation, and to more impact relevant quantities, such as short duration heatwaves, floods, droughts and storm surges, remains challenging. This is largely because small scale processes developing over small time scales are not adequately represented by climate models which typically run at a coarser resolution. Such is for instance the case in heavy precipitation events where cloud processes are crucial. Also, the land-atmosphere exchanges of heat and water are rather poorly covered by observations (Seneviratne et al. 2010, Teuling et al. 2010), leaving climate models surface fluxes poorly constrained (de Noblet-Ducoudré et al., 2012; Stegehuis et al., 2012). Such interactions have been shown to be determinant in the development of droughts and heatwaves (Seneviratne et al. 2006, Vautard et al. 2007, Diffenbaugh et al. 2007, Hirschi et al. 2011, Quesada et al. 2012, Mueller and Seneviratne 2012).

A new approach that has been taken is to run atmosphere only models in order to constrain the conditions to those pertaining in a particular season to the actual observed sea surface temperatures and in order to allow higher resolution and larger ensembles. This approach was taken in an analysis of the floods in England and Wales in Autumn 2000 which damaged nearly 10,000 properties and caused insured losses estimated at £1.3 billion (Association of British Insurers, 2001; DEFRA, 2001, Pall et al, 2011). Model results from this study indicated that anthropogenic greenhouse gas emissions had increased the risk of the floods occurring by more than 20% in 9 out of 10 cases and in two out of three cases by more than 90%.

In the first BAMS report "Explaining extreme events of 2011 from a climate perspective" (Peterson et al, 2011), similar types of studies found that human influence substantially altered the probabilities of the Texas heatwave of that year, the very warm temperatures seen in the UK that November and the very cold start to the British winter of 2010/11. In addition, the report considered other techniques, notably an analysis of European temperatures comparing observed temperatures with those expected during circulation analogues (Yiou et al., 2008; Vautard and Yiou, 2009) of past decades (Cattiaux and Yiou, 2012). This analysis showed that temperatures in 2011 were distinctly warmer than expected from flow analogues. While 2011 was the warmest in Western Europe since 1948, the analysis showed that it would have been an unexceptional year based on the circulation characteristics of that year without long-term warming. In addition the report contained an analysis of the Thailand floods of 2011 which considered observed diagnotics of rainfall and concluded that while the flooding on the Chao Phraya river was unprecedented, the rainfall was not very unusual, indicating that non climate factors were more important in setting the scale of the disaster (van Olderborgh, 2012). Such observationally based analyses provide a method for putting recent extreme events into the context of climate variability and change which can be applied very quickly in the days following the event in question.

Such studies indicate that by using suitably designed ensembles of climate model simulations and more empirically-based methods it is possible to put recent extreme weather events into the context of climate variability and change and to calculate any changed risk of recent events that is attributable to human and natural influences on climate. Such attribution assessments arouse major interest in the media and from policy makers and only two months after it was published the first BAMS attribution report (Peterson et al, 2012) was already the most read American Meteorological Society paper of the last year, indicating that there is a great appetite for such information (Nature, 2011).

B.1.2.2 Main limitations at present

To date, event specific attribution studies have only been attempted for a relatively small number of specific cases. Because the details of the methodologies are often being developed at the same time as the analysis being undertaken it can take a long time for the results to come to fruition, (eg the assessment by Pall, 2011 of 2000 UK floods). Different approaches have been used, including simple statistical approaches, and a range of different climate modelling strategies, and how results from different approaches relate is not well understood. Consequently, contributions to the first BAMS annual attribution supplement on extreme weather and climate events of 2011 (Peterson et al, 2012) were few in number, used studies that required the use of simplifying assumptions in order to generate results in time for publication, and were difficult to relate to each other because of the diversity of approaches taken.

Even amongst the relatively small number of studies already published, there are apparently conflicting results appearing for the same event, as was the case for the Russian heatwave of 2010, natural variability being blamed in one case (Dole et al, 2011) and human influence in another (Rahmstorf et al, 2011) as the major contributory factors. A demonstration that these different results can be reconciled once it is recognised that they are seeking to explain different aspects of the heatwave, its magnitude in the former case, and its probability in the latter (Otto et al, 2012), points to the need for careful framing of attribution questions so that they are seen to fairly reflect the current state of evidence. The lack of such a framework continues to lead to public confusion, with a consequent risk to the credibility of attribution science.

A further risk to the credibility of attribution products is if they are based on inadequate models that generate results that are not robust. Attribution studies inherently rely on models (statistically or physically based) to generate counterfactual worlds from which to estimate attributable changes in weather risks. At present, many model-based attribution assessments rely heavily on “perfect model” assumptions, and while model biases may be openly discussed in such studies (eg Rupp et al, 2012), the methodologies are often lacking to link model biases to the levels of confidence that can be assigned to particular attribution statements. Some initial work has demonstrate the potential for using reliability measures from seasonal forecasting to characterise the robustness of attribution results (Chrisitidis et al, 2012c) but it isn’t clear how to translate such measures into overall confidence statements. Crucially, verification of models used for attribution requires process-based approaches that diagnose the mechanisms behind a particular event in order to understand whether they are represented in the models used. For instance, soil moisture-climate interactions play an important role for the occurrence of drought and heatwaves in several regions (Seneviratne et al. 2010, Mueller and Seneviratne 2012), but current models strongly vary in their representation of the relevant underlying processes (Koster et al. 2004, Boe and Terray 2008, Quesada et al. 2012), and in some cases even display shared biases (Hirschi et al. 2011). Without sufficient mechanistic understanding, it will remain unclear where attribution science is still too uncertain to make robust assessments of change in risk, clarity on which aspect is needed for determining future research needs.

Biases and poor sampling in observational datasets also affect robustness of attribution studies, yet this aspect remains poorly assessed. Observational records of sufficient length and quality are often lacking in many regions even for temperature and precipitation (Alexander et al. 2006). Furthermore, the lack of data is particularly critical for non-meteorological variables such as soil moisture or runoff (Seneviratne et al. 2012), or energy and water surface budgets which are directly related to high-impact events such as droughts and floods. Even though Europe is relatively fortunate in having available datasets such as the ECA&D dataset for temperature and precipitation, data products coming out of the Euro4m project, space information being developed under the ESA CCI (e.g. for surface soil moisture), there is a lack of extensive observationally based diagnostics to evaluate climate models for attribution, and some satellite-based datasets also need to be evaluated for their suitability for climate applications

(for instance a first version of the WACMOS/ESA CCI soil moisture dataset has only been released in 2012, and the validation and evaluation of this dataset for drought diagnostics is still underway). Such diagnostics need to be targeted at the atmospheric and land surface processes most closely involved in the development of the climate or weather extreme in question.

Last and most importantly, while attribution assessments of individual weather and climate events have attracted considerable media attention (eg Stott et al, 2004, Dole et al, 2011, Peterson et al, 2012), and a diverse range of user groups, including policy makers, reinsurance companies and legal experts, expressed an interest in obtaining such information at the Attribution of Climate-related Events meeting in September, 2012, the full set of requirement of such stakeholders for attribution products has not yet been properly elucidated. As a result, the tolerance of potential decision-making processes to uncertainties and possible errors in attribution assessments is not yet well understood.

All of the above individual limitations add to one over-riding limitation, namely that a central plank of climate services that links monitoring and prediction services, that of attribution services (Trenberth,2008) [http://www.cgd.ucar.edu/cas/Trenberth/trenberth.papers/WMO-BullJan08.pdf] remains under-developed relative to its sister components. EUCLEIA aims to address this limitation.

B.1.2.3 EUCLEIA will move beyond the state of the art in:

1. Identification of user needs. By engaging with targeted groups of stakeholders in a systematic and comprehensive fashion from start to finish of the project, EUCLEIA will demonstrate the value of attribution products for European decision makers. Starting with an in depth assessment of user requirements from stakeholder groups, attribution products will be designed to meet user needs and their utility will be assessed based on a carefully chosen set of test cases of past extreme weather and climate events;
2. Development of a set of methodologies for the production of regular, reliable attribution products. This will include the development of a suite of statistically-based and climate-model based methodologies that can be applied in a regular and routine basis. An important component is the provision of a set of robust methodologies for calibrating confidence levels of assessments. A suite of verification tools will be developed for statistical and physically based models, including those used in seasonal forecasting models. The outcome will be the provision of calibrated confidence levels for assessments (analogous to those used in IPCC assessments), based on sound physical principles and communicated in such a way as to be of value for users in their decision making processes;
3. Development of effective ways to overcome limitations associated with spatial resolution of models in describing loaclised extreme events. There are three strands to how resolution limitations will be addressed. First the base model for the attribution service in WP8, HadGEM3-A, will be upgraded to higher spatial resolution (N216, approximately 50km in mid latitudes, a development that will be carried out in parallel with the seasonal forecasting activity in the Met Office). The sensitivity of attribution results to spatial size will also be explored by making parallel high resolution ensembles using both the nested regional model design and global model experiments. Finally, the reliability assessment methods of WP6 will provide information to users about the extent to which a user can place trust in results from attribution products given the current spatial resolution of models.
4. Provision of a quasi-operational attribution system. The centre piece of this system will be the HadGEM3-A climate model, running at seasonal forecast resolution (links to SPECS, EURPORIAS) and delivering results each season and annually for publication in the BAMS report putting extreme events of the previous year into the context of climate variability and change In addition, a system for delivery of statistically-based analyses of observationally based information and for calculation of attribution products based on pre-existing coupled model simulations from the CMIP5 archive for “fast-track” services in the days following events will also be developed;
5. Development of comprehensive and transparent analyses of the effects of methodological choices. This will permit clear user-focused communication of the significance of such choices and of the overall faming of the attribution problem. An important aspect of this will be to ensure traceability between the different components of the attribution system so as to ensure consistency of treatment and robustness between fast-track and seasonal to annual timescale results;

6. Development of an extensive suite of process-based diagnostics. The diagnostics developed by EUCLEIA will be targeted at the key mechanisms responsible for the types of weather and climate events considered and will be used in model verification as well as in the provision of user-focused attribution assessments. EUCLEIA will exploit links to other European projects developing in-situ and satellite based observational datasets including the ESA Climate Change Initiative (CCI; of which the Met Office leads the Climate Modelling User Group) and EURO4M;
7. Identification of those areas where attribution science is still too uncertain to make a robust assessment of change in risk. Two key aspects of WP6 will be to identify a) observation gaps and b) methods to assess and communicate the extend to which users should place trust in results from attribution products, including where capability remains too limited for robust assessment. These aspects will be explored by two different tasks of WP6. In pointing the way towards the limitations in current attribution systems, EUCLEIA will seek to minimise over-reliance of user groups on contingent information, as well as inform future research priorities. The understanding gained in EUCLEIA on the limitations of current attribution systems will facilitate the further development of the next generation of attribution systems;
8. Identification of observational gaps and needs for improving attribution. EUCLEIA will identify the variables, frequency and spatial coverage needed for the events under study. The observables discuss will both help in the detection of changes and in the evaluation of model's ability to reproduce key processes involved in the events.

B.1.3 S/T methodology and associated work plan

B.1.3.1 Overall strategy and general description

The aim of EUCLEIA is to develop a quasi-operational attribution system for the delivery of attribution products on a series of timescales following weather and climate events (fast track in the week following the event, each season disseminated to the EUCLEIA stakeholder group, and annually to the BAMS annual attribution supplement). The project starts by defining user needs in WP4 and runs through to the delivery of attribution products in near-real time in WP8. Recognising the core role of users and the development and delivery of the operational attribution system, WP4 and WP8 form the outer skeleton of EUCLEIA. Methodological development is carried out in WP5 and the development of diagnostics, model evaluation and the development of reliability assessments is carried out in WP6. The outputs of WP5 and 6 will be used in the course of a set of test cases on five types of weather event in WP47, informed by the user requirements developed in WP4 and using the attribution system developed inWP8. Finally in the last year of the project, the attribution system developed in EUCLEIA will be run regularly, in quasi-operational mode, to produce attribution products related to weather and climate events as they happen in Europe. This last component of WP8 draws together all the elements developed in the other WPs in EUCLEIA and includes dissemination and feedback from users to inform the next steps in the development of fully operational attribution systems.

A set of case studies are identified in WP7 which include some notable weather and climate events seen in Europe in recent years, including heatwaves, cold spells, floods, droughts and storm surges. We choose to restrict EUCLEIA to five classes of events in order to allow sufficient depth of analysis of the value and limitations of the attribution system for each of these types of event. In addition, we concentrate on Europe to ensure that EUCLEIA focuses, both from the science and stakeholder perspective, on its core mission of development of attribution services for our region. However EUCLEIA will also work very closely with international partners from other continents including US, Australasia, Africa and Asia actively engaged in developing attribution science. Moreover the methodology, and most of the diagnostics will be applicable to other regions, so EUCLEIA will be a flagship project with a potential for worldwide development. This is particularly important in the current stage of construction of the Global Framework for Climate Services. We will be able to compare results from different models when applied to different regions, discuss the development of methodologies, and collaboration with our international group of EUCLEIA partners (funded for attendance at annual EUCLEIA meetings) will enable us to incorporate international best practice in the science of event attribution into our endeavour.

The generation of sensitivity studies is required to inform the development of reliable attribution systems. Sensitivity studies on methodological choices are carried out in WP5 and sensitivity studies to elucidate the role of different mechanisms in the classes of events we study are carried out in WP6.

Throughout the project, significant effort will be put into outreach and dissemination of project findings, to stakeholders, to the scientific community and to the general public. We will discuss our latest results with stakeholder groups seasonally, will input results to the annual BAMS attribution report, will submit papers to the peer-reviewed literature, and will present results at scientific conferences and workshops (including IDAG, ACE, AGU, AMS). Suitable results from peer reviewed publications, including the BAMS annual attribution supplement, will be disseminated to the public via press offices and the external EUCLEIA website.

B.1.3.1.1 Data flow

EUCLEIA will incorporate observational and model information generated outside the project but will also generate a substantial amount of data from climate model simulations generated internally. The diagram below shows schematically how data is expected to be distributed to the different WPs. Relevant information from observational and reanalyses and model information from the CMIP5 archive and from EC-Earth will be acquired by WP5 for use in testing the sensitivity of attribution results to model structure and in the development of "fast track" attribution methodologies applied to observational and CMIP5 model data. Climate model data generated by WP5 is then distributed to WP6 for the development of diagnostics and for model evaluation techniques. The diagnostics and reliability measures developed in WP6 flow in to WP7 where they are applied to a set of test cases. Information from these test cases is then used to inform the development of the quasi-operational attribution system in WP8. Suitable results from WP7 and WP8 will contribute to the BAMS attribution report on extreme events of the previous year in the last year of the project. Output from WP8 is also used to deliver attribution products to stakeholders via WP4 as part of a quasi-operational attribution service. Finally results produced by WP8 will be compared with sensitivity studies carried out in WP5 to understand the sensitivity of results to model structure.

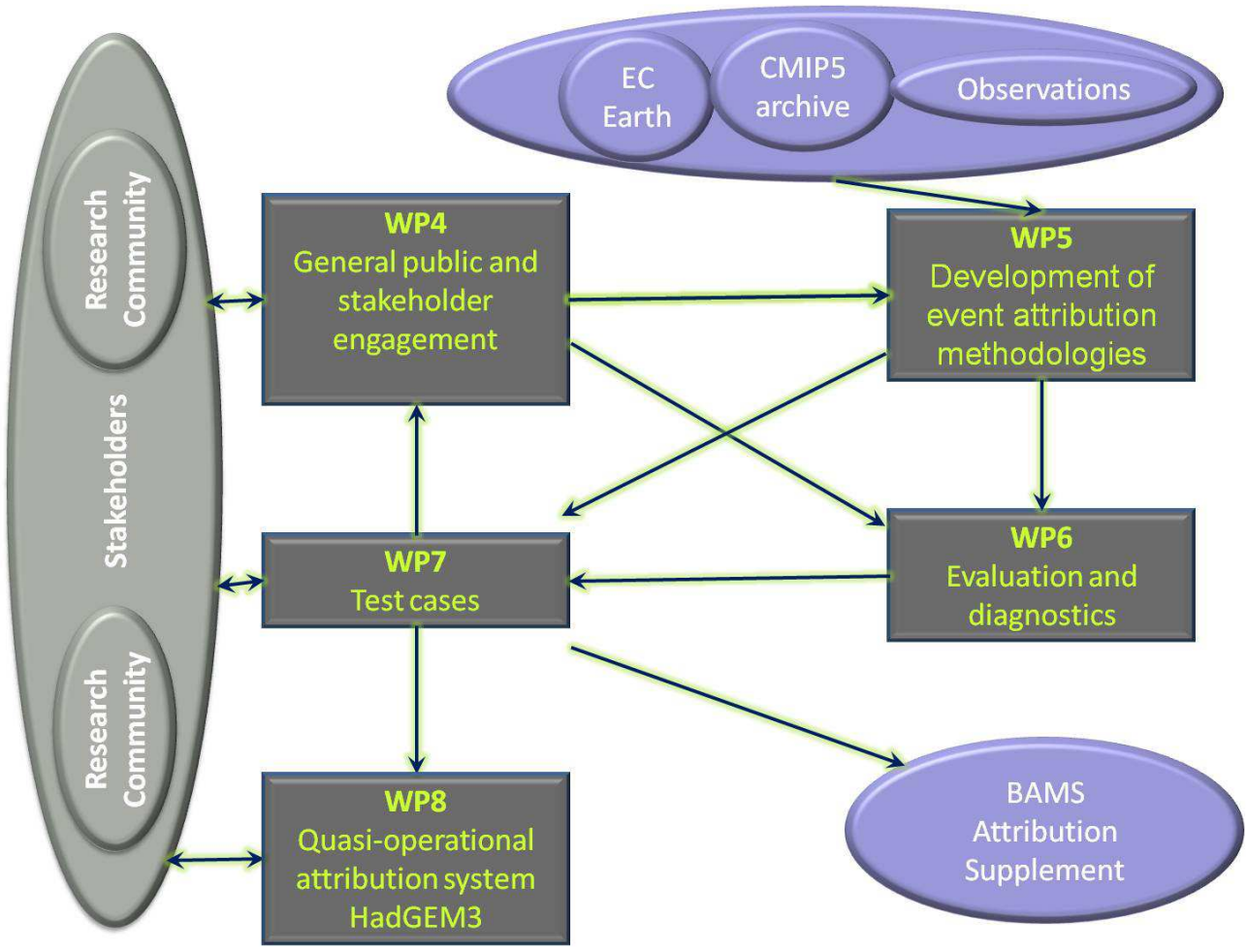


Figure 1: EUCLEIA Data Flow

B.1.3.1.2 Graphical presentation of the components showing their interdependencies

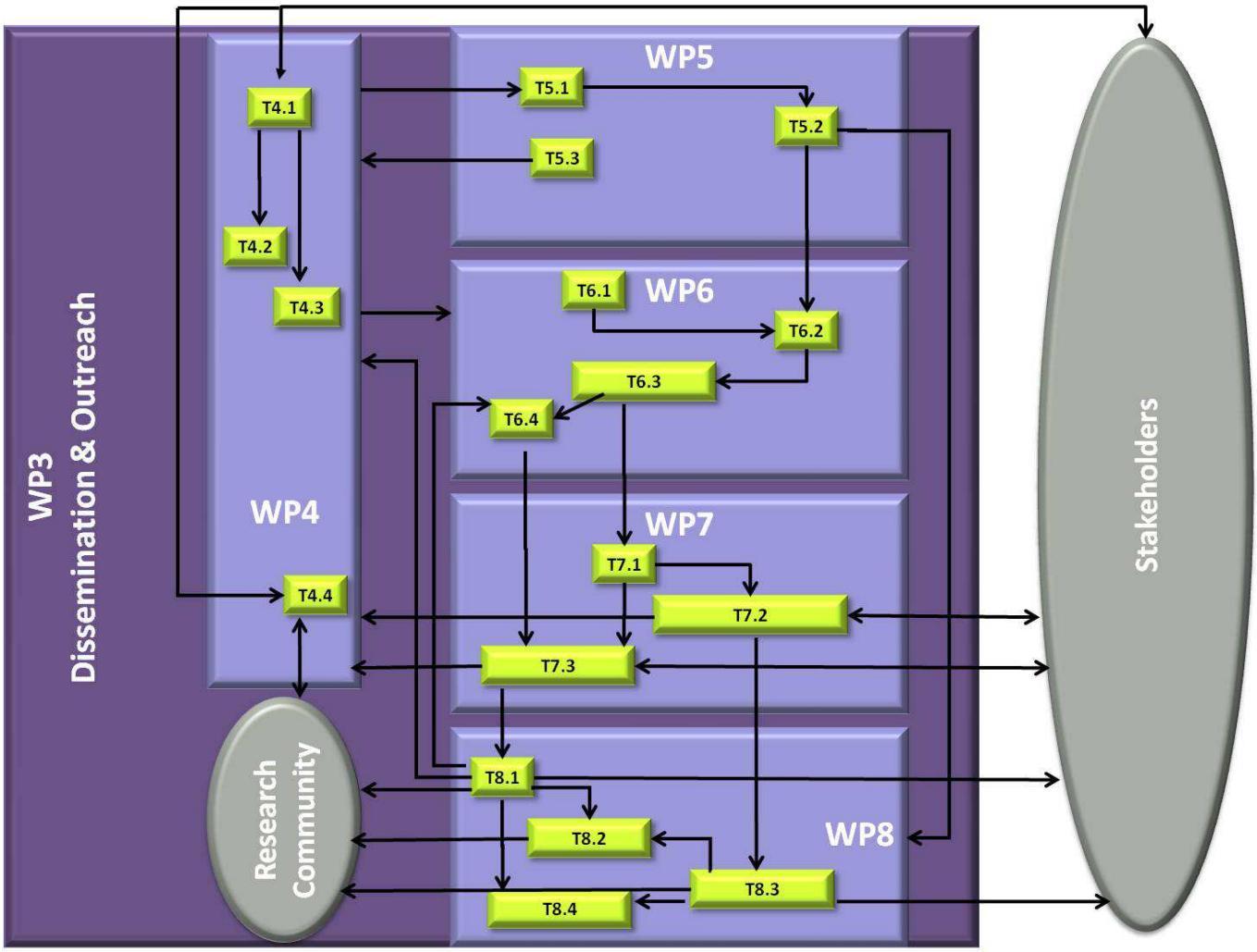


Figure 2: EUCLEIA Interdependencies Schematic

B1.3.1.3 Significant risks and associated contingency plans

EUCLEIA, like all projects, is susceptible to risks, arising from the ambitious (but realistic) objectives, inherent risks associated with undertaking research, and by breaking new ground in developing a quasi-operational attribution service.

The Met Office has developed expertise in the management of risks in this context through other large projects such as ENSEMBLES and EUPORIAS. The Project Office, supported by the Met Office's Risk Manager, will draw on the knowledge and experience of partners within the consortium and will ensure that risks within EUCLEIA are managed effectively through the project.

Within EUCLEIA, risks can be categorised into scientific, and managerial. The significant risks and associated contingency plans are described below.

Scientific risks

The development of novel attribution systems based on development and application of cutting edge methodologies and the use of state of the art climate models is an important element of EUCLEIA. The model that will form the

core of the project, HadGEM3-A, has already been developed for use in producing event attribution results, thus demonstrating the feasibility of the basic design of the quasi-operational attribution system proposed. Further developments will be needed to increase the resolution and to automate the production of model simulations. The risks to delays in this development will be mitigated by close collaboration with the seasonal forecasting team at the Met Office and by ensuring that the attribution system uses the same atmospheric component as the seasonal forecasting model and is kept up to date with the latest developments in the seasonal forecasting model. Likewise, the feasibility of the empirical methods proposed for use in fast-track assessments has already been demonstrated in the first BAMS attribution report produced in 2012. This therefore minimises the risk that such methods will not be available for use in EUCLEIA, although clearly the ambition of the project is to make substantial developments in the sophistication of such methods and to apply them to a much wider range of extreme weather and climate situations. We will help to ensure the scientific integrity of the project by presenting our results to collaborators in the ACE and IDAG groups and through submitting our work to peer review.

A small advisory board, drawn from scientific experts who are members of IDAG, will provide independent advice and recommendations about improvements to the projects work plans and techniques, thereby minimising the risk of the project going off track in its development of new methodologies and approaches. The EUCLEIA management board will take stock after each meeting of the Advisory Board and develop contingency plans to mitigate the risks identified with the project. Objectives and priorities will be adjusted where barriers to progress are identified. While it is expected that observations of the basic meteorological variables of temperature, precipitation will be available for the project, there are risks associated with non availability of other data being collected in WP6 although these have been mitigated by identifying observational datasets that should be publically available during the course of EUCLEIA. Where observational data are not available as expected, objectives will be adjusted apprpriately, and any such non availability issues will inform one of the main objectives of the project, namely the task to identify current observational gaps for event attribution.

In breaking new ground in making attribution assessments of a much wider range of extreme weather and climate events, and on a much faster timescale than hitherto, there is a risk that some attribution results produced by EUCLEIA could be misused in some way. For example, there is already a history of media reports jumping to conclusions about human induced climate change being definitely responsible, or not responsible, for certain extreme weather events that have occurred in recent years. The risk of inappropriate misuse of attribution results from EUCLEIA will be minimised through two key elements of EUCLEIA. First, a principle driver of EUCLEIA is to develop the methodologies needed to be able to communicate the level of trust users can have in attribution results for their application, and to understand the impact of methodological choices so that attribution assessments developed in EUCLEIA are seen to provide a fair reflection of the current evidence. Second, results from EUCLEIA will be carefully disseminated. Results will only be published if the methodologies being employed have passed peer review. Furthermore we will take advantage of the close involvement of stakeholders at all stages in the project to minimise the risk of misuse and misinterpretation of results. Initial results from the quasi-operational attribution system will be disseminated to the stakeholder group, so that we can fully understand the issues of interpretation, and thereby minimise the risk of misuse and misinterpretation of results. It is important to stress that we do not intend to provide a fully operational attribution service as part of EUCLEIA providing all results direct to the public, because the risks of misinterpretation and therefore to the long-term credibility of event attribution science, if results are put out unmediated are simply too great. Rather, by developing a quasi-operational attribution system, by testing it out on recent extreme weather and climate events, and through careful dissemination of the results, we intend to lay the ground work for a fully operational attribution capability for Europe as part of the future development of climate services.

Whilst unlikely to occur, should any partner need to withdraw or leave the consortium, a process for replacing partners or re-allocating the associated work that would have been done by the partner who has left, is part of the formal consortium agreement.

Managerial risks

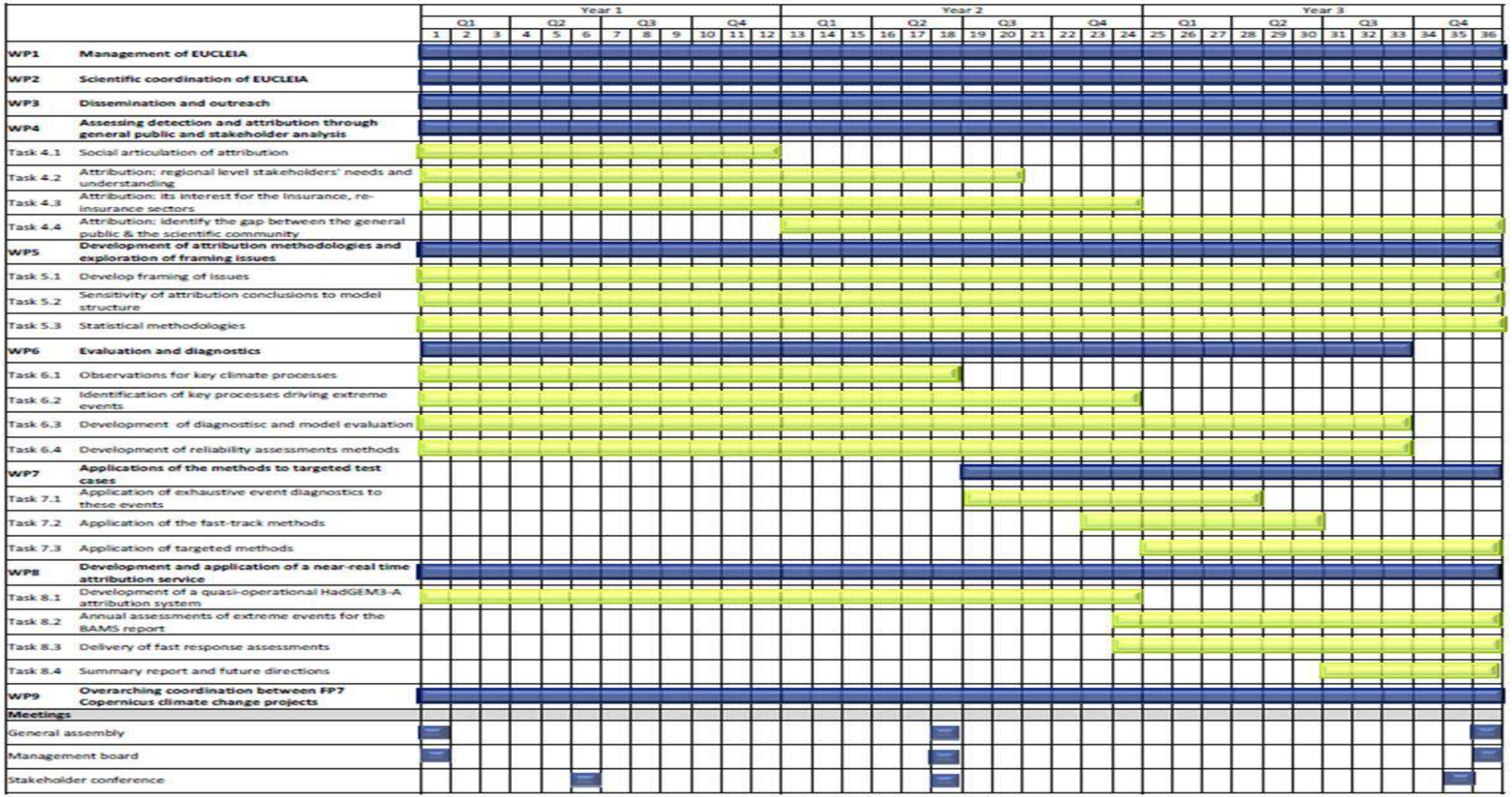
EUCLEIA brings together a group of internationally renowned climate experts and their teams to work on an exciting and innovative project. Partners will work together to assist any partners that need to recruit people to work on the project.

The Coordinator can draw on considerable experience at the Met Office in running large FP projects and will have access to a wealth of experience from partners during the operation of EUCLEIA. The management structure has been clearly set out in Part B2.1 to ensure that EUCLEIA will minimise the project management risks, such as delays to Work Packages and Tasks.

The recruitment and retention of suitably experienced researchers and stakeholders could be a risk. The project has already identified the leaders in the development of event attribution science in Europe, has recruited the leading scientists throughout the rest of the World to participate as non-funded partners, and has identified a critical mass of stakeholders needed to make the project successful. While recruitment of additional stakeholders may strengthen the project it is retention of stakeholders that is the biggest risk. This will be mitigated by using existing contacts to enthuse and recruit stakeholders. The risk of not retaining stakeholders will be mitigated by ensuring they are fully engaged with the project throughout.

During the consortium agreement phase, a comprehensive risks register will be created along with appropriate management of the risks. Whilst in general, consideration will be given to reducing the risks through mitigation strategies, ultimately the identified risks will be retained and monitored. However, consideration will have to be given to avoiding and sharing risks where appropriate.

B.1.3.2 Timing of work packages and their components



B.2 Implementation

B.2.1 Management structure and procedures

B.2.1.1 EUCLEIA Management Structure

EUCLEIA brings together a number of European partners, and will have strong interactions with stakeholders in order to develop and deliver user-driven attribution products. It is therefore essential the project has an effective management structure and decision-making procedures, as described below. The aims of the management structure and procedures are to ensure that as well as managing the project on a day to day basis, individual strands of the project are fully integrated so that full benefit can be realised from the output of each work package.
To achieve this, a management theme (WP1 – WP3) has been included in the project. The primary purpose of this management theme is to ensure activities carried out throughout the project are fully integrated towards a common purpose; and the project is able to deliver the benefits in full to the stakeholders, users and wider community. The management theme will provide top level management of the project, ensuring research is carried out in an effective and efficient manner and progress is reported to the European Commission/Research Executive Agency (REA) on a regular basis. The management theme has has three work packages; WP1 (Management of EUCLEIA), WP2 (Scientific Coordination of EUCLEIA) and WP3 (Dissemination and Outreach).

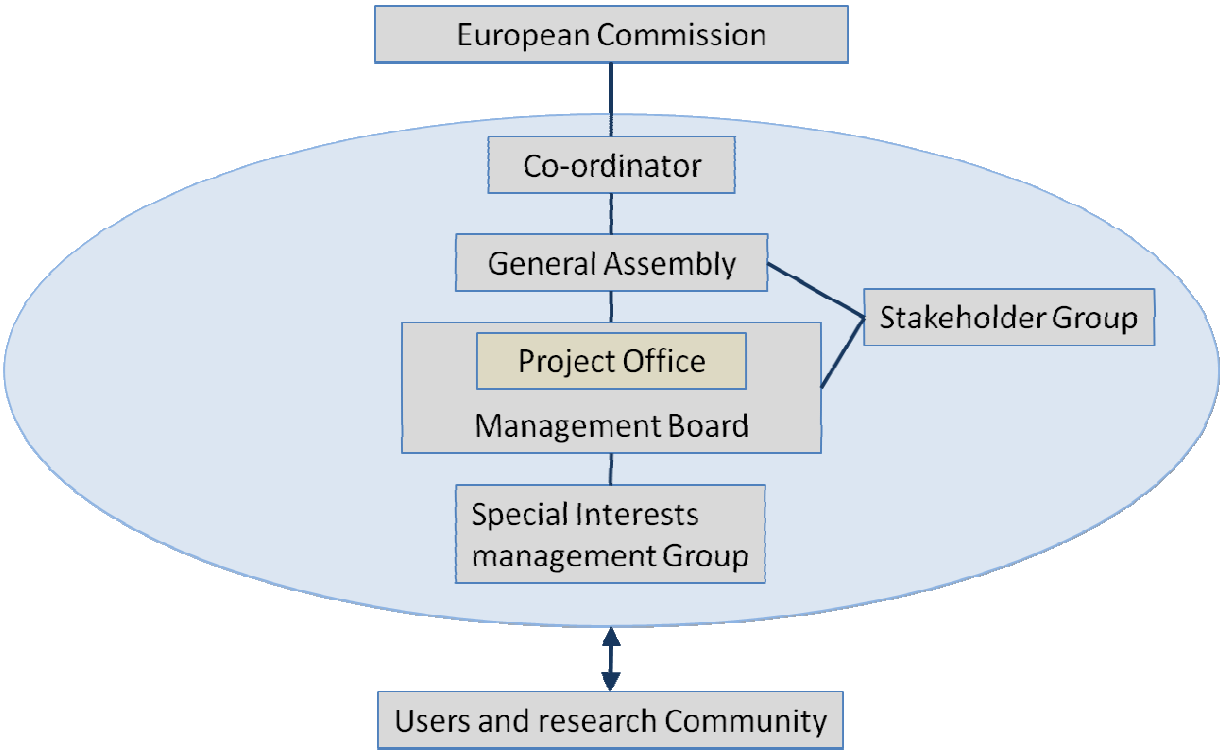


Figure 3: EUCLEIA Management Structure

The management structure is designed to manage the interactions and information exchange between partners, project administration, the European Commission/Research Executive Agency and stakeholders in as rapid and efficient a manner as possible. The structure has been kept as simple as possible to optimise important interactions between all parties.
The project will be coordinated by Dr Peter Stott, from the Met Office, who has considerable experience in the international attribution community and in leading large projects. All project administration and management of financial reporting and contractual matters will be handled by a team at the Met Office,

supported by experienced legal, finance and communication teams, with extensive experience of European Framework Programmes.

Details of the components of the management structure, identified in Figure 3, are given below, together with the specific roles and responsibilities of individuals associated with each group. In summary:

- The General Assembly of all partners is the primary decision-making body for the project;
- The Management Board will be the supervisory body ensuring a successful execution of the project;
- The day-to-day management of the project will be conducted by the project office;
- The Special Interest Management Group (SIMG) will be convened to provide specialist advice to the Management Board on issues such as IPR, ethics and gender balance;
- The Stakeholder User Panel will influence and advise on project activities from a stakeholder/user perspective;
- The Advisory Board will provide independent advice on the project's progress and plans from the perspective of external experts.

B.2.1.1.1 General Assembly

The General Assembly consists of one member of each of the partner institutions. Its purpose will be to:

- act as the final decision-making body for the project;
- discuss progress of the project and plans; and
- advise the management board on matters relating to the work plan.

Meetings will be held at least once a year, including one at the start of the project and a final meeting at the end of the project.

Any member of the General Assembly may, provided it has written support of 50% or more of the consortium members, request that the EUCLEIA coordinator convene a General Assembly. This must then be convened at the earliest practicable opportunity. Decisions made by the General Assembly will be acted on by the project office or the Management Board as appropriate, where the decision has been supported by at least two thirds of the partners.

Members can attend the meeting and vote in person, appoint a proxy to vote on their behalf or register their vote in writing prior to the meeting if they cannot attend.

B.2.1.1.2 Management Board

Overall management and oversight of the project will be carried out by the Management Board, who will be responsible for:

- acting on the decisions of the General Assembly;
- ensuring work packages are fully integrated;
- sharing knowledge as widely as possible across and beyond the project;
- agreeing the work plan;
- recommending resolutions for any disputes between partners;
- ensuring the proper operation of the consortium, including financial management, reporting, communication,
- delivering the aims, deliverables and milestones of the project.

In the event of changes to the consortium composition or budget allocation changes, the Management Board will make recommendations for the General Assembly to approve.

The Stakeholder User Panel (discussed below) will be represented on the Management Board and at the General Assembly by the Science Coordinator (discussed below). The Special Interests Management Group (discussed below) will be formed as required by the Management Board and will be represented on the Management Board by the Project Manager.

Management of Risk

The Management Board will be responsible for risks, issues and benefits realisation of the project. Day-to-day maintenance of the registers will be undertaken by the project office.

Membership of the Management Board

The management board will consist of:

- EUCLEIA coordinator (chair of the board);
- Project manager (reports to the board);

- Science coordinator;
- All work package leaders;
- EUCLEIA administrator (secretary for the board);

For quorum at Management Board meetings, all of the following must be present, although they may appoint a deputy if they are unable to attend;

- EUCLEIA coordinator or a representative from the project office (to chair the meeting);
- A WP leader or representative from each WP.

The Management Board will meet at project inception and thereafter at each of the general assemblies. Additional meetings can be called at any time as required by any member of the management board. However, these can be conducted via video-conferencing/Skype/Webex if appropriate. Voting on any matters will be based on a simple majority of the management board. If no majority is reached; then the coordinator, or delegated chair, will have the casting vote.

B.2.1.1.3 EUCLEIA Coordinator and Project Office:

EUCLEIA will be co-ordinated in all the administrative, financial and management aspects by the Met Office Management tasks include:

- Administrative and financial management: Responsibility for distributing finances and payments to all project parties; monitoring and controlling the budget; and providing necessary financial reports to the REA;
- Providing clarification on any budget and financial issues arising;
- Scheduling, organising and chairing the standard consortium meetings; such as inception and final meetings;
- the General Assembly meetings (in collaboration with appropriate partners); the Management Board meetings, and Special Interests Management Group meetings;
- Providing support and planning tools for work package management. This includes resource management, reporting mechanisms, and checklists for actions and decisions;
- Managing, monitoring and reporting on progress of the project against the agreed deliverables and milestones.
- Any significant modifications of the work plan (as agreed by the Management Board) also need to be managed;
- Ensuring that the project risks, issues and benefits are recorded and well managed;
- Managing the Special Interests Management Group. This group will be comprised of various partner members;
- Providing the necessary coordination with other EU-funded, and international, projects.

Membership and Responsibilities of the Project Office

EUCLEIA Coordinator (Dr Peter Stott)

Responsible for the overall coordination of the project; coordination with other EU funded and international projects; chair of the management board; communicating with the REA on agreements and deviations from agreed plans; acting as the project point of contact for the REA; point of contact for the advisory board. Reports to the European Commission/REA and is assisted by the project manager and science coordinator.

Science Coordinator (Dr Nikolaos Christidis)

Responsible for monitoring scientific progress of the research themes and work packages; provides science leadership for the project; coordinating the scientific work of the research themes and work packages; leading the case studies coordination; member of EUCLEIA management board; chair of the stakeholder group. Reports to the EUCLEIA coordinator and is assisted by the work package leaders.

Project Manager

Responsible for facilitating internal communication within the project; scheduling meetings of the project; providing regular communications to the EC and the EUCLEIA Coordinator; managing, monitoring and reporting of project finances and budget; leading the Special Interests Management Group and represents the group on the Management Board; management of the risks, benefits and issues registers. Reports to the Management Board and is assisted by the EUCLEIA administrator.

EUCLEIA Administrator

Responsible for assisting with the communication between the different groups; organising meetings of the project; assisting with management, monitoring and reporting of project finances/budget; assisting with maintenance of the risks, benefits and issues register; providing secretarial support to the EUCLEIA coordinator, project manager and science coordinator. Reports to the project manager. specialist support (e.g. finance, legal and communications) will be provided to the project office by the appropriate Met Office departments; and other partners institutes when necessary.

Overarching coordination with the other FP7 Copernicus Climate Change projects
EUCLEIA is one of five successful FP7 projects from the 2013 FP7 Space call (along with ERA-CLIM2, UERRA, QA4ECV and CLIPC). These projects share the common objective to prepare for a future operational Copernicus Climate Change Service. An overarching coordination team has been set up to ensure proper coordination among these projects. This team consists of the coordinators of the five projects and Dr Albert Klein Tank from KNMI. The objectives and tasks of this coordinating team are laid out in WP9.

B.2.1.1.4 Special Interests Management Group
The Special Interests Management Group (SIMG) will be formed as required to provide specialist advice on the management of aspects of Intellectual Property Rights (IPR), ethics and gender, complaints and dispute resolution. The project manager will co-ordinate these activities and report to the general assembly and management board on behalf of the SIMG. The ultimate responsibility for the management of these matters will remain with the management board and the general assembly, depending on whether the matter relates to the work plan or to issues affecting partners respectively.

IPR, Ethics and Gender Aspects Management
IPR issues will impact all partners and the IP management will be a regular task for the SIMG. IP management is detailed under Part B.3.2. Ethics issues are detailed in Part B.4 and Gender aspects in Part B.5 of this Document.

Dispute resolution
In the event of a dispute between partners, the SIMG will form a temporary panel to identify a resolution to the dispute. The resolution will be passed back to the management board or general assembly as appropriate via the project manager for action to be taken.

Complaints Management
In the event that any complaints are received about the project, a panel from within the SIMG will be formed to manage the complaint through to a successful resolution. The resolution will be passed back to the management board or general assembly as appropriate via the project manager for action to be taken.

B.2.1.1.5 Stakeholder Group
A stakeholder is an invited individual or organisation who has a specific interest in the activities and outputs of the project, such as the tools and techniques that are being proposed. Stakeholders bring high levels of sector- and subject-specific knowledge that will be used to help develop the project's deliverables, including the case studies and the climate service prototypes. They will be able to participate in the work packages and provide support and advice throughout the project. The stakeholder group is already well advanced (a subset of those identified have provided letters of support – see Appendix 4) and will be formally formed just after the project start). There will be three stakeholder conferences, one near the start of the project, one at the mid-point and one at the end. Other stakeholder meetings will be arranged with appropriate partners as required.
The stakeholder group will be chaired by the science coordinator, who will also represent them on the Management Board and at the General Assembly.

B.2.1.1.6 Advisory Board
This small independent group will be created by the EUCLEIA Coordinator, and will be made up of distinguished experts in the area of climate science and climate servivces. The advisory board members will provide independent advice and recommendations about improvements to the project's work plans, tools and techniques. Consulting with the advisory board will ensure that the deliverables, milestones and

associated products and prototypes of EUCLEIA, support the overall aims of EUCLEIA and parallel European and international policies (such as the WMO GFCS). The advisory board will receive information detailing the project status and results. The advisory board is currently composed of:

- Dr. Claudia Tebaldi (Head of IDAG, Climate central)
- Prof Francis Zwiers (Director, Pacific Climate Impacts Consortium)
- Dr Thomas Peterson (Chief scientist NCDC, Chief editor of BAMS attribution issue)
- Prof David Karoly (University of Melbourne, Australia)
- Dr Sten Bergström (SMHI, Sweden)

The advisory board will meet at each of the general assemblies (those members who cannot travel will participate by phone) and by phone conference at six montly intervals.

B.2.1.2 Dissemination and Communication Strategy

It will be important to communicate effectively both internally within the project, and externally beyond the project. Communication within EUCLEIA has the potential to be complicated by the disparate and disloated nature of the partners. Every effort will be made to minimise the requirement for face to face meetings by the use of e-mail, the internet, teleconferencing, video conferencing, Skype and other forms of remote communication that may be available. To ensure that partners are kept informed with the way the project is progressing, an internal website will be set up. All project reports and documents will be available through this website. Communications beyond the EUCLEIA partners and stakeholders will be coordinated by the project office (WP1). The dissemination of project results is described in detail in Part B.3.2, and an updated Dissemination Plan will be developed at the start of the project.

B.2.2 Beneficiaries

Partner 1: Met Office (short name Met Office)

Brief description of the organisation:
The Met Office is the UK's National Weather Service. It includes the Met Office Hadley Centre (MOHC) with 180 employees who specialise in climate research and prediction to inform decision-making. The Met Office employs a total of 510 Scientists. The Met Office is a Trading Fund within the UK Government's Department for Business, Innovation and Skills. This status engenders a business approach in addition to our R&D activities resulting in successful products and service delivery.
The Met Office has developed and delivered climate services within the UK and internationally for many years. Users are from a variety of sectors including water, energy, health, transport, agriculture and tourism. These services inform decision-making for adaptation and mitigation to climate variability and climate change. The development of the Met Office's Climate Service is a key strategic aim to satisfy customer requirements. Over the last few years the Met Office has been at the forefront of research into climate variability and predictability; development of operational ensemble-prediction systems, derived applications and products for seasonal to decadal timescale.
The Met Office is highly active in numerous international climate service-related activities, including

- WMO's GPCs for long-range forecasts. Outputs from these will be part of climate services in Europe;
- WMO's key strategic activity to develop the Global Framework for Climate Services (GFCS): Involvement in writing the Implementation Plan being written for approval by WMO Extraordinary Congress;
- Climate Services Partnership (CSP): Co-organised the First International Conference on Climate Services in October 2011. This led to the creation of the CSP, where the Met Office has a seat on the Core Group;
- FP6 ENSEMBLES project: Co-ordinated by the Met Office. The footing for climate services in Europe;
- FP7 EUPORIAS project. Co-ordinated by the Met Office. Developing end-to-end climate impact prediction services;
- Other EU FP projects, e.g.: EUCLIPSE - Climate cloud processes; ERA-CLIM - Global climate re-analyses; ICE 2 SEA - Sea and sea-ice processes for climate; and COMBINE - Improvements in climate modelling.

Tasks assigned/Role in the project:
The Met Office will coordinate and manage EUCLEIA and lead WP8. Its research activities will include the assessment of user needs and vulnerabilities, assessment of dynamical downscaling, climate information indices, development of complex impact models, quantifying and communicating uncertainty in impact models and developing a framework for dealing with uncertainty, the use of climate information in decision-making, developing climate service prototypes and delivery tools, engage with stakeholders, and assess climate services as a business opportunity.
Short profile of key personnel involved:
Dr Peter Stott: Scientific Strategic Head for the Climate Monitoring and Attribution area of the Met Office Hadley Centre. He leads the development of the scientific research aiming to provide better observational evidence base for responding to climate variability and change and to improve understanding of the causes of observed changes. Apart from scientific publications in leading journals, Peter has been heavily involved in the production of IPCC reports, as lead author in the 4th Assessment Report and co-ordinating lead author in the 5th Assessment Report. He also has considerable experience in communicating scientific findings about climate to the public and has given many media interviews, including on TV, radio and to many print journalists.
Dr Nikolaos Christidis: Senior Climate Change Attribution Scientist. He has extensive experience of developing and applying detection and attribution methodologies to identify possible causes for changes in climate extremes. He has led research that provides real-time attribution information for regional temperature extremes and developed a prototype system for an attribution service that will deliver regular assessments of the human contribution to recent extreme events. This information is essential to inform decision making and adaptation planning.
Dr Richard Jones: Scientific manager responsible for the development of the new Met Office Hadley Centre regional climate modelling, HadGEM3-RA and its application in the WCRP Coordinated Regional Downscaling Experiment CORDEX. Lead author of the Regional Context chapter of IPCC Working Group 2 Fifth Assessment Report and Met Office focal point for the UNFCCC Nairobi Work Programme providing advice on climate projections, scenario development and application and downscaling relevant to climate change adaptation.

Partner 2 – Eidgenoessische Technische Hochschule Zurich (short name: ETH Zurich)

Brief description of the organisation:
The Swiss Federal Institute of Technology (**ETH Zurich**) was founded in 1855 and is the leading Swiss university in the areas of natural sciences and engineering, with about 17,000 students and 10,000 staff. Currently it is ranked among the 15 best universities in the world and 5 best universities in Europe according to the QS World University ranking. The **Institute of Atmospheric and Climate Science** at ETH Zurich has long and wide-ranging expertise in climate research, atmospheric physics and chemistry, and hydrology. The institute has a staff of about 130 researchers, technicians and Ph.D. students. The **Chair of Land-Climate Interactions** investigates the role of land surface processes in the climate system using global and regional climate models, land surface models, diagnostic estimates, ground and satellite observations, and field measurements. Climate model evaluation and process-based analyses with respect to land surface processes and land-climate interactions, including their contribution to drought and heatwave dynamics, belongs to the core expertise of the research group. The research group is highly active in numerous national and international climate research projects, including:
- ESA CCI soil moisture project (Leader of climate research component): Evaluation of new WACMOS / ESA CCI soil moisture product, assessment of historical soil moisture trends, model evaluation;
- EU-FP7 EMBRACE project (WP leader, Land processes): Process-based evaluation and bias reduction of current Earth System Models with respect to land surface processes and land-climate interactions;
- EU-FP7 DROUGHT-RSPI project: Past and projected drought trends, evaluation of drought representation in current climate models, subseasonal and seasonal drought forecasting; EU-FP7 Carbo-extreme project (executive board member): Impacts of extreme events on terrestrial carbon cycle;
- NRP61 DROUGHT-CH (SNF; Lead PI): Early warning of drought in Switzerland and Central Europe.

Tasks assigned/Role in the project:
ETH Zurich is involved in WP6 and WP7. In WP6, it will lead Tasks 6,1 and 6.2. Task 6.1 coordinates the compilation of observational datasets, including space-based observations, for the evaluation and validation of the models used in the project, while Task 6.2 coordinates sensitivity experiments for the mechanistic assessment of the processes contributing to the occurrence of the investigated extreme events. In WP7, it will lead the case-studies based assessment of drought attribution, and use an extension of the WP6-based sensitivity experiments for the mechanistic investigations of the case study events.

Short profile of key personnel involved:
Sonia Seneviratne, Assistant professor and chair of the land-climate interactions research group, is an expert in land-atmosphere interactions, hydrometeorology, and land surface and climate modeling. She has published over 60 scientific articles in this research area, and is active in several national and international research projects. She was coordinating lead author of the physical chapter of the Intergovernmental Panel on Climate Change (IPCC) special report (2009–2012) on "Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)". Furthermore, she is a Scientific Steering Committee member of the Integrated Land Ecosystem-Atmosphere Processes Study (iLEAPS), a member of the World Climate Research Program's Global Energy and Water Cycle Experiment (GEWEX) Data and Assessment Panel and Global Land/Atmosphere System Study (GLASS).
Edouard Davin has expertise in land surface modeling and regional climate modeling, as well as in the assessment of impacts of land use/land cover changes for regional and global climate. He has led the development of the COSMO-CLM^2 regional climate model, which is used by a broad community.
Lukas Gudmundsson is a specialist in large-scale hydrology, focusing on the impact of climatic drivers on continental scale hydrological dynamics. He has expertise in modern statistical techniques, bias correction methods and approaches for diagnostic land-surface model validation.
Martin Hirschi has expertise in the compilation and assessment of observation-based datasets. in statistical data analysis and statistical downscaling, and in the assessment of soil moisture-temperature feedbacks and climate change impacts.
Boris Orlowsky has expertise in climate data analysis, ranging from station data to global climate model output. His most recent focus is the quantification of trends and uncertainty in multi-GCM CMIP5 projections with respect to droughts and other extreme events. He was a contributing author to the recent IPCC SREX report.

Partner 3 National Centre for Scientific Research (short name: CNRS)

Brief description of the legal entity: CNRS (National Center for Scientific Research) also know as Labratoire des Sciences du climat et de l'environnement (short name: CNRS -LSCE)is a government-funded research organization, under the administrative authority of France's Ministry of Research. As the largest fundamental research organization in Europe, CNRS carried out research in all fields of knowledge. The CNRS/LSCE laboratory will be involved in EUCLEIA. It is a joint research unit from *Centre National de la Recherche Scientifique* (CNRS), the *Commissariat à l'Energie Atomique* (CEA) and the University of Versailles – Saint Quentin en Yvelines, which employs currently 160 permanent staff in the fields of climate analysis, modelling and observation. LSCE is in particular active in the statistical analysis of climate time series and extreme weather. It has participated and led a number of national, European and international projects.
Main tasks attributed: CNRS will lead WP6 on diagnostics and evaluation and specifically the task on evaluation of the processes in the attribution models. It will also provide heat wave and cold spell indices and circulation regimes in this WP. CNRS will also largely contribute to WP5 by developing an ensemble of statistical indices and a methodology using circulation analogues in order to better compare extreme events with past events and detect changes. It will provide these tools to WP7 and WP8.
Previous experience relevant to the tasks: CNRS has extensive experience in climate research. Over the past years it was involved in several international projects concerning climate analysis including eg IMPACT2C, CMIP5, PMIP, CORDEX, and the climate KiC. Development of statistical methods including analogue methods, extreme value, spectral methods and downscaling methods and associated theory has been a major research topic of LSCE for years. Tens of peer-reviewed articles have been published in this area. Recently a diagnostic activity has taken place where regional modelling is also used for assessing drivers of temperature extremes.

Short profile of staff members undertaking the work:
Robert Vautard (CNRS)has 25 years research experience in atmospheric and climate science: climate analysis, regional climate modelling including atmospheric chemistry. He has experience in climate studies, through weather regime and climate extreme time series analysis, as well as several modelling studies using the WRF and IPSL-CM models. He has published around 120 peer-reviewed articles and has an experience in management; he was head of LSCE between 2006 and 2010. He is deputy director of the Paris Climate Consortium (http://www.gisclimat.fr), whose objective is to foster interdisciplinary research on climate change impacts, and is chairing the research programme of the L-IPSL excellence laboratory of Institut Pierre-Simon Laplace, which helped initiating projects on climate extremes. He is a WP leader in two FP7 projects (IMPACT2C, ATOPICA). Collaboration with **Julien Cattiaux,** following his PhD work on the evolution of temperature extremes and detection of changes using advanced statistical methods, will be continued.

Chantal Pacteau (CNRS) joined CNRS in 1983 as a researcher. An agronomist, she has also a PhD in cognitive science. As the Ex-deputy director of CNRS international relations directorate, she has also expertise in the science and society dialogue. She is currently deputy director for interdisciplinary of the Paris Climate Consortium (http://www.gisclimat.fr). She is leading the French team of the project " *New Territories: Urban Rooftops in Regard to Energy and Life Styles… Learning from Chicago, Montreal, Paris* " launched by the Atelier international du Grand Paris (http://www.ateliergrandparis.com/news/?p=1894).

Mathieu Vrac (CNRS) is a researcher in statistical climatology and environment, focussing on stochastical downscaling, bias correction and extreme events modelling, with an original look, complementary of the purly physical approaches. Over the last years, he has been involved in various projects: ANR SHIVA (expert), McSim (WP leader), AssimilEx, MedUP, and GIS-projects as WP leader (REGYNA and PEPER). Currently, he is coordinator of the French ANR project StaRMIP aiming to inter-compare the main statistical downscaling approaches and studying their impacts for hydrological modelling. He is co-PI of the international VW-project PLEIADES and is the French representative (and WG leader) in the European COST action "VALUE".

Pascal Yiou (CEA) is an experienced researcher, with expertise including time series analysis and extreme value theory for climate. He has coordinated an FP6 project (Extreme Events: Causes and Consequences), several French ANR projects, and has participated to three FP and many ANR projects on climate variability.

Partner 4 – University of Edinburgh (short name: UEDIN)

Brief description of the legal entity:

The University of Edinburgh is one of the largest and most successful universities in the UK with an international reputation as a centre of academic excellence. The University is the leading research university in Scotland and is amongst the top ten in the United Kingdom. Almost all members of staff at the university are research active. Following the results of the 2008 Research Assessment Exercise some 63% of the University's research activity is in the highest categories (4* and 3*), of which one third is recognised as "world-leading". The results place the University in the top 5 in the UK and number one in Scotland by volume of 4* "world-leading" research. Traditionally the University has been very successful in participating in European Framework Programmes. Currently in the Seventh Framework Programme the university participates in some 187 projects with an award value of €116M. Further, the University takes a lead role in several large scale Collaborative Projects. It is the University's stated aim that it wishes as far as possible to conduct its research and development activities on a trans-national basis.

Previous experience relevant to the tasks:

The College of Science & Engineering is in the front rank of UK University science and engineering groupings for research quality and research income. In the most recent (2008) UK Research Assessment Exercise the College of Science & Engineering continues to be a top performer, 96% of the research was classified as world-leading in terms of originality, significance and rigour. 42% of the world-leading scientists and engineers in Scotland are at the University of Edinburgh, and all seven of the Schools within the College are in the top 6 in the UK in their disciplines. The College is also a key player in European research collaborations, participating in 125 projects in Framework 6 and to date 128 projects in Framework 7. The College also currently has 14 ERC awards.

Short profile of staff members undertaking the work:

Simon Tett is Chair of Earth System Dynamics and Modelling at the University of Edinburgh where he also, in 1992, received his PhD. He previously worked at the Hadley Centre as a research scientist and showed that human emissions of carbon dioxide were likely to be responsible for 20th century warming. After this he managed a team of scientists who created datasets of historical climate change from the atmosphere, sea and land surface and the sub-surface ocean with uncertainty estimates. He has carried out and analysed simulations of the climate of the last 500 years. He has contributed to observing system studies and published more than 50 peer-reviewed papers, won the Norber-Gerbier WMO prize twice (1997, 1998), a NOAA prize for best scientific paper (1998), the L G Groves prize for Meteorology (2006) and gave the Margary lecture to the Royal Meteorological Society in 2007. He contributed to the last three IPCC assessments, is a review editor on the 5th assessment report and provided scientific advice to the UK government. He is a PI on NCAS and NCEO funded projects as well as a RAPID-WATCH project. Tett will lead the Edinburgh bid

Gabriele Hegerl is Chair of Climate System Science. Hegerl published the first paper showing that the anthropogenic influence on surface temperature changes is detectable and can be separated from natural influences, and contributed to the first paper showing that global precipitation patterns have changed due to human influences. Her research also demonstrated that daily extreme temperature and precipitation precipitation extremes show detectable changes. Hegerl has published more than 90 papers in the peer reviewed literature and was a Coordinating Lead Author) of the IPCC 4th Assess. Report, Working Group I, and a drafting author of the Summary for Policymakers. She is a Lead Author for the 5th Assessment report and a member of the synthesis report writing team. Hegerl serves on a variety of committees including the MOHC science review group, and is presently PI on three NERC grants, co-I on an NCAS grant, as well as on a RAPID NERC grant (both PI'ed by Simon Tett) and another NERC grant (PI Sandy Tudhope). She has recently been notified that her bid for an ERC advanced fellowship has been recommended for funding. **Hegerl and Tett's joint research group** supports a vibrant research group that presently comprises three graduate students and four PDRAs, many of them co-supervised; and an NCAS PDRA (to be appointed). Hegerl will lead the temperature extremes component.

Partner 5 – Fundacio Institut Catala De Ciencies Del Clima (short name: IC3)

Brief description of the legal entity:

The Institut Català de Ciències del Clima (Catalan Institute of Climate Sciences, IC3, Spain) is funded by the Catalan government and aims at developing high-quality research on climate variability and prediction, and its impacts. The Climate Forecasting Unit (CFU, http://ic3cfu.wikispot.org), the research unit involved in this project strong of 15 scientists and technicians, undertakes research on the development of dynamical and statistical methods for the prediction of global and regional climate on time scales ranging from a few weeks to several years. The formulation of the predictions includes the development and implementation of techniques to statistically downscale, calibrate and combine dynamical ensemble and empirical forecasts to satisfy specific user needs in the framework of the development of a climate service. Making progress in dynamical global climate modelling with a focus on monthly-to-decadal climate prediction is one of the main objectives of the CFU, for which it uses the EC-Earth and develops initialization methods that allow improving different aspects of the forecast quality. The assessment of the sources of predictability and the limitations of current climate prediction systems to exploit them, especially over Europe, Africa and South America, inspires many of the publications of the unit. The CFU is currently involved in five FP7 projects, QWeCI, DENFREE, CLIMRUN, SPECS and EUPORIAS, and several nationally- and privately-funded projects.

Tasks assigned/Role in the project:

IC3 will contribute to WPs 6, 7 and 8. Its research activities will include contributing to apply and extend measures developed in seasonal forecasting for assessing the reliability of attribution statements in Task 6.4, to the development of the model-based attribution that could be performed using the information available at a time frame of 6-9 months on the basis of the reliability information in Task 7.3, and to develop a prototype near-real time attribution system for seasonal time scales based on ensembles generated with the HadGEM3-A in Task 8.1. These contributions will aim at developing a climate service prototype that enhances business opportunities.

Short profile of key personnel involved:
Prof. Francisco J. Doblas-Reyes is a worldwide expert in the development of seasonal-to-decadal climate prediction systems and the head of the CFU. He is involved in the development of the EC-Earth ESM since its inception. He is an IPCC lead author (Fifth Assessment Report), serves in several WCRP and WWRP scientific panels, has participated in a number of FP4 to FP7 projects, is coordinator of the FP7 collaborative project SPECS and is author of more than 60 peer-reviewed papers. He is shaping IC3's plans for the development of European climate services.
Dr. Isabel Andreu-Burillo is a senior scientist with more than 15 years of experience in operational and research oceanography, including the development of data assimilation codes, in institutions of France, United Kingdom and Australia.

Publications:
Guémas, V., F.J. Doblas-Reyes, F. Lienert, Y. Soufflet and H. Du (2012). Identifying the causes of the poor decadal climate prediction skill over the North Pacific. J. Geophys. Res., 117, D20111, doi:10.1029/2012JD018004.
van den Hurk, B., F.J. Doblas-Reyes, G. Balsamo, R. Koster, S. Seneviratne and H. Camargo Jr. (2012). Soil moisture effects on seasonal temperature and precipitation forecast scores in Europe. Climate Dyn., 38, 349-362, doi:10.1007/s00382-010-0956-2.
Du, H., F.J. Doblas-Reyes, J. García-Serrano, V. Guemas, Y. Soufflet and B. Wouters (2012). Sensitivity of decadal predictions to the initial atmospheric and oceanic perturbations. Climate Dyn., 39, 2013-2023, doi:10.1007/s00382-011-1285-9.

Partner 6 – Danmarks Meteorologiske Institut (Short Name: DMI)

Brief description of the organisation:

DMI is the national meteorological service for Denmark, Greenland and the Faeroe Islands. Through scientific research and development, DMI secures the optimum accomplishment of its tasks and serves the community with up-to-date information on weather and climate and other geophysical issues. Research areas include climate science, oceanography, development of the DMI-HIRLAM numberical weather forecasting system, and middle atmosphere physics. The Danish Climate Centre at DMI has extensive experience in research on climate variability and on regional and global climate modelling. The modelling experience includes studies of climatic sensitivity to external forcing, natural climate variability, seasonal and decadal prediction as well as model development. The Danish Climate Centre has taken part in numerous EU supported projects on global and regional climate modelling and science of the middle atmosphere, recently including ENSEMBLES, PRUDENCE, SCOUT-O3, COMBINE etc.

Tasks assigned/Role in the project:

DMI will mainly contribute to work packages 5, 6 and 7. In WP5, DMI will develop and apply an ensembles surrogate technique to attribute extreme events to either natural variability or climate change. In WP6, DMI will identify key mechanisms and processes of extreme events related mainly to winter cold spells (Arctic sea ice, Northern Annual Mode). In WP7, DMI will lead the in-depth analysis on cold spells.

Short profile of key personnel involved:

Bo Christiansen, Senior Scientist, has addressed a number of topics focussed on atmospheric dynamics circulation regimes, climate sensitivity, the coupling between the troposphere, climate sensitivity and paleo-reconstructions. The overarching issue has been statistical methods. He has made extensive use of climate models but he has also experience with simpler models such as one-dimensional radiative-convective models. He has co-ordinated two international research projects, CliChem and ROCS, financed by the European Commission. In the period 2001-2005 he was a member of the board for the Climate Programme (KlimaProg) under the Norwegian Research Council. He has authored or co-authored more than 50 refereed papers.

Peter Thejll, Senior Scientist. Extensive experience in statistical analysis of climate data. Peter has worked on climate change attribution studies in the context of the Sun-Climate proposal. He has gained modelling experience from the Quantify project where a model for airplane contrail advection was investigated, plus extensive experience with ENSEMBLES data in terms of emergence of climate change signals in temperature and preciptation over Europe. Peter has also carried out investigation into drought indices and their evolution in historic data and based on the ENSEMBLES scenario data, plus radiance modelling of Earth scenes based on DWD CMSAF project Earth Observation data.

Shuting Yang, Senior Scientist. Extensive experience in areas of climate modelling, climate variability and climate change. Shuting's work covers topics including atmospheric circulation regimes, climate sensitivity and feedbacks, and climate prediction and projections - by using both idealised, simplified circulation models and Earth System models. Shuting is in charge of global climate model development at the Danish Climate Centre and involved in the development of the European Earth System model (EC_Earth) and its CMIP5 simulations. He is a Panel Member for Natural and Engineering sciences under the Swedish Research Council, 2012.

Partner 7 – Koninklijk Nederlands Meteorologisch Instituut (short name: KNMI)

Brief description of the organisation:
The KNMI (Royal Netherlands Meteorological Institute) is the Dutch national weather service and centre for climate research. Climate research at KNMI is aimed at observing, understanding and predicting changes in the climate system. KNMI produces climate scenarios for use by stakeholders for developing adaptation and mitigation strategies and climate reports describing and attributing regional climate change in the Netherlands. It has a strong climate research component grouped around a global climate model (EC-EARTH), a regional climate model (RACMO), satellite (eg OMI and TROPOMI) and in-situ observations (ECA&D database) and climate analysis (Climate Explorer). The latter two activities are part of the Regional Climate Centre (RCC) for WMO Region VI. KNMI is dedicated to using world-class research to make climate information and knowledge to its end users. This is shown by

- responsibility for regional climate data archives (ECA&D, SACA&D);
- co-ordination of the development of the European climate model EC-EARTH;
- co-ordination of EU projects (EUCLIPSE, EURO4M);
- participation in EU-projects (ENSEMBLES, THOR, COMBINE, EMBRACE, SPECS);
- participation in event attribution initiatives, such as the article "Explaining Extreme Events of 2011 from a Climate Perspective" (BAMS, 2012);

In the research plans for 2012-2015, event attribution is a research priority for KNMI.

Tasks assigned/Role in the project:
KNMI will perform SST-forced runs with the EC-EARTH global model for the period 1962-2012, investigate selected events at a higher resolution (WP5), and develop an energy budget method (WP6) to investigate the source of heat and moisture of extreme events. KNMI will lead the work package dedicated to the application of the methods on selected test cases (WP7), investigating floods itself and co-ordinating the investigations into heat waves, cold spells, droughts and storm surges by the partner institutes. KNMI will set up a fast-track attribution system that pulls together all observations and models that are available within a few days in order to be able to make a preliminary attribution statement on the media time scale of one week (WP8).

Short profile of key personnel involved:
Dr. **Geert Jan van Oldenborgh** is senior researcher in the Global Climate Research division of KNMI. He is a climate analyst with a strong background in statistical analysis of observations, seasonal and decadal forecast verification, and climate event attribution. As the author of the KNMI Climate Explorer he makes large amounts of climate observations, analyses and model output available for analysis to the wider climate-interested community. He is Lead Author for the IPCC WG1 AR5 (Chapter 11, Near-term projections and predictability, and Annex I Atlas).
Prof. **Wilco Hazeleger** is head of the Global Climate Division of the KNMI. He is a climate scientist with a wide experience in coupled atmosphere-ocean modeling. His research has been directed at interannual to decadal variability in the ocean-atmosphere system, weather extremes in a changing climate and the transfer of knowledge from the climate community to the users of the information. Currently he coordinates the EC-EARTH project.
Dr. **Albert Klein Tank** has been working as a scientist at KNMI for more than 20 years now. He is actively involved in observational research embedded in international projects and programmes. Albert co-ordinates the European project EURO4M which develops regional reanalyses of past weather and user-oriented data products for monitoring climate variability and change in Europe (see www.euro4m.eu). He leads the European Climate Assessment & Dataset project that joins over 40 meteorological services in Europe and the Mediterranean. ECA&D delivers high quality observational datasets and information services on changes in weather and climate extremes (see eca.knmi.nl). Albert is also involved in the production of the 2007 and 2013 assessment reports of the IPCC. Currently, he co-chairs a global expert team on the topic of detection and attribution of anthropogenic climate change. On a national level, he co-ordinates the climate change scenarios for the Netherlands constructed by KNMI for local adaptation. Albert has published papers in scientific journals, as well as policy relevant reports (see www.knmi.nl/~kleintan).

Partner 8 – University of Reading (short name: Uni Reading)

Brief description of the organisation:
The Department of Meteorology at the University of Reading is the largest in Europe with over 20 teaching staff, 80 research staff and around 50 PhD students. It has received the highest research rating of 5* in all UK Research Assessment Exercises, indicating an international reputation in all aspects of research. It is a member of Reading's Walker Institute for Climate System Research, established to promote integrative research across the University. The Department hosts the Climate Directorate of the UK's National Centre for Atmospheric Science (**NCAS-Climate**). The NCAS-Climate group at Reading provides a strategic programme in modelling and understanding the climate. It currently consists of over 40 scientists, more than half of whom are on grants from NERC, EU and other organisations. NCAS-Climate has strong links with the UK Met Office and works closely with them on many aspects of climate model development and evaluation, and applications to understanding climate variability and change, and predictability and prediction.

NCAS-Climate has played major roles in numerous European and national projects that are directly related to EUCLEIA, including:

- Leading EU PREDICATE which pioneered European research in decadal climate variability and predictability;
- EU THOR investigating the role of the Atlantic Meridional Circulation in European Climate variability and change;
- EU SPECS which is addressing the development of seasonal forecasts and related climate services for Europe;
- NERC TEMPEST and NERC TEA-COSI consortium projects which are investigating the impact of climate change on European climate.

Tasks assigned/Role in the project:
The University of Reading will contribute to WP5, WP6 and WP7. Its research activities will include performing experiments with uncoupled atmosphere and coupled atmosphere-ocean mixed-layer climate models to assess the sensitivity of attribution results to air-sea interaction (WP5); performing sensitivity experiments and developing diagnostic indices to determine the role of sea surface temperatures, sea ice and aerosol in the development of extreme events (WP6); and assessing the role of sea surface temperatures and sea ice in the development of the specific extreme events being studied in WP7. NCAS-Climate has extensive experience in performing such climate model experiments and developing our understanding of the role of air-sea interaction and regional drivers in climate variability and change, gained - for example - through the projects identified above.

Short profile of key personnel involved:
Dr. Len Shaffrey is a Senior Scientist in NCAS-Climate based at the University of Reading. Dr. Shaffrey is the Senior Atmospheric Scientist for the NERC High Resolution Modelling Programme and led the development of the HiGEM high-resolution coupled climate model. He is also leading a project to jointly deliver, with the UK Met Office, decadal climate predictions using HiGEM. Dr. Shaffrey is the Lead Principal Investigator for the TEMPEST consortium project, which is investigating how extratropical cyclones will respond to climate change, and a Principal Investigator for the NERC TEA-COSI consortium project which is researching the impact of a seasonally sea ice free Arctic on the wider climate system.

Prof. Rowan Sutton is the Director of Climate Research for NCAS. He is a Lead Author (chapter 11) for the IPCC fifth Assessment Report. Previously he was a Royal Society University Research Fellow and NERC's Climate System Theme Leader. Professor Sutton leads a research group on seasonal-to-decadal climate variability, predictability and prediction. Professor Sutton has led pioneering research in the field of decadal climate prediction. He was coordinator the EU PREDCIATE project and is currently a Principal Investigator in the related EU THOR and SPECS projects. He is also Principal Investigator of the NERC VALOR consortium, which is researching the value for climate predictions of the RAPID array observations of the Atlantic Meridional Overturning Circulation.

Partner 9 – University of Oxford (short name: UOXF)

Brief description of the organisation:
The University of Oxford is consistently ranked amongst the top-ten research universities in the world. With substantial recent and ongoing investment in physical climate science research, faculty and infrastructure (such as supercomputing), the University now employs ~120 staff directly working within climate science research groups, utilizing a substantial stream of research funding from the UK's NERC, the European Research Council and FP7 collaborative programmes. The University has existing formal links to the European Center for Medium Range Weather Forecasting, and NERC's National Centre for Atmospheric Science, alongside many strong collaborative links with the UK Met Office, which have recently been strengthened by the University's inclusion in the Met Office's Academic Partnership scheme. The Oxford e-Research Centre (OeRC) hosts the climateprediction.net weatherathome distributed computing project, which provides a key resource to this consortium.

Tasks assigned/role in the project: The primary role of UOXF is to test various approaches to attribution under WP5 and contribute to test implementation in WP7. Simulations driven with reanalyses will be undertaken in-house using the Oxford Supercomputer, while remaining tasks will use distributed computing, which allows large ensembles to be undertaken at low cost and minimum environmental impact, requiring nine person months in OeRC for coordination. Attribution experiments with reanalyses and using prescribed observed and natural SST forcing will be set up and analysed by a PDRA in SoGE under Prof. Allen (24pm, 12 in WP5 and 12 in WP7), while exploring the impact of SSTs from a multi-model ensemble of seasonal forecasts (EUROSIP) will be performed by a PDRA in Atmospheric Physics under Dr Weisheimer (24pm in WP5) also linking to the FP7 SPECS project on seasonal and interannual predictions. The PDRA in SoGE will work with the Met Office to extend models to include atmosphere-ocean-mixed-layer interactions and updated atmospheric physics (9pm in WP5). The use of distributed computing provides a valuable public outreach opportunity, which the **Oxford Climate Knowledge Exchange Fellow, Pete Walton**, will coordinate. Dr Walton will also contribute to the stakeholder engagement and interpretation of attribution research (3pm in WP4).

Short profile of key personnel involved:

Professor Myles Allen, FInstP, is Professor of Geosystem Science in the School of Geography and the Environment (SoGE) and Department of Physics, University of Oxford, and coordinator of the Oxford University Climate Research Network. His research focuses on how human and natural influences on climate contribute to observed climate change and risks of extreme weather and in quantifying their implications for long-range climate forecasts. He has served on the IPCC on Detection of Climate Change and Attribution of Causes for the 3rd & 5th Assessments and on Global Climate Projections for the 4th Assessment. Professor Allen is Principal Investigator of climate*prediction*.net, one of the world's most successful Citizen Science distributed computing projects, with an experienced team working with the UK Met Office and international partners performing the worlds largest ensemble climate modelling experiments. In 2010 he was awarded the Appleton Medal by the Institute of Physics.

Dr Antje Weisheimer: Antje Weisheimer is an NCAS Senior Research Fellow in Oxford's Physics Department (Atmospheric, Oceanic and Planetary Physics). Her research interests include: model-based weather and climate forecasts and the uncertainties associated with them; predictability on seasonal to decadal time scales; and seamless prediction of weather and climate. Weisheimer is also employed at the European Centre for Medium-Range Weather Forecasts (ECMWF) in Reading and is a Research Fellow at Wolfson College Oxford. Currently she leads a work package on Addressing Model Inadequacy in the EU FP7 project SPECS (Seasonal-to-decadal climate Predictions for the improvements of European Climate Services). It is understood that only the element of Dr Weisheimer's Salary that is paid by the UOXF can be charged to the project.

Partner 10 – Helmholtz-Zentrum Geesthacht Zentrum Fur Material- Und Kustenforschung GmbH (short name: HZG)

The *Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung GmbH* (HZG) is one of 18 members of the Helmholtz Association of German Research Centres. HZG is located in Geesthacht near Hamburg with a total staff of approximately 850 employees. The main HZG research areas cover materials science, as well as environmental research focussing on *marine, coastal and polar systems.* Research at HZG is both problem- and user-oriented and covers basic as well as applied research including the production of laboratory prototypes. About 68 % of HZG's annual budget (104 million Euro in 2011) is provided by the national federal and states governments, while 32 % are generated via additional income such as EU and national research projects, contract research, and licensing of HZG patents for products and processes. HZG maintains central administrative, financial, legal and project management departments providing its researchers with full support in all related issues. HZG has gained experience for years and has cultivated a successful tradition in both the co-ordination of and participation in different types of EU projects. Since the year 2000, researchers at HZG have coordinated some 35, and have participated in more than 110 EU projects co-financed by the European Commission through FP5, FP6 and FP7 priority programmes.
The *Institute of Coastal Research* is one of the institutes of HZG; its department "Systems' Analysis and Modelling" deals with climate, climate change and climate impact in coastal zones, with special emphasis on storms, storm surges and ocean waves. This work is done in close connection with various regional stakeholders; for building a dialogue with public, media and stakeholders a unit named "Norddeutsches Klimabüro" has been set up in 2006; in the staff of the institute there are several social scientists, who help to embed the scientific work into a social context.

Tasks assigned
Two groups of the Institute of Coastal Institute are involved in EUCLEIA, namely the Norddeutsches Klimabüro, who will be responsible for the contribution to WP4 (surveying and interviewing public and stakeholders about concepts of detection and attribution and about the utility of the envisaged EUCLEA product), and the "Regional Climate" group2; which will be responsible for the storm surge case in WP7.

Short profile of key personal involved
Prof Dr. Hans von Storch: Director of "Systems' Analysis and Modelling" of Institute for Coastal Research, who is responsible for the strategic dimension of the contribution of HZG; as driving force behind the concept of regional climate service, and the implementation of such activities such as knowledge assessments on regional climate change for the Baltic Sea catchment (BACC) or the metropolitan region of Hamburg. Co-chair of BALTEX, a regional science body for the Baltic Sea. Member of IDAG (International Detection and Attribution Group). (WP4,7)
Dr. Insa Meinke: Head of Norddeutsches Klimabüro, with experiences in multi-year interactions with different stakeholders and segments of the public in Northern Germany; doing surveys and running focus groups; building "products" (Norddeutscher Klimaatlas) for public use from institute's results. (WP4)
Dr. Dennis Bray: Sociologist, doing internet-based surveys among scientists and regional stakeholders since many years. Member of the project RADOST on climate change impacts and perceptions along the German Baltic Sea coast. (WP4)
Dr. Armineh Barkhordarian: Research scientist, who recently received her PhD for doing a comprehensive analysis of the consistency of ongoing climate change in the Mediterranean Sea region with scenarios of GHG-driven climate change; contributor to IDAG-activity. (WP7)

Partner 11 – Université de Versailles Saint-Quentin-en-Yvelines (short name : UVSQ)

Brief description of the organisation:
The Université de Versailles and Saint-Quentin-en-Yvelines (UVSQ) will participate in EUCLEIA through its "Observatoire des Sciences de l'Univers", the « Observatoire de Versailles and Saint-Quentin-en-Yvelines » (OVSQ). Specialised in climate, environment, and sustainability sciences, OVSQ has as research mandate to foster interdisciplinary science and graduate education. Its interdisciplinary approach and the complementary nature of its laboratories have created an incubator for new alliances, for emerging synergies and scientific progress. The observatory, with a strong commitment to research and international involvement, is a participant in leading-edge satellite observation programmes, contributes to international networks for environmental risk analysis, for environmental humanities, for global atmospheric monitoring and for understanding climate change, past, current and future. A spearhead of sustainable development for UVSQ, the Observatory groups five research labs, three transverse thematic groups, including one on environmental health; OVSQ counts more than 600 research staff/scientists and 650 graduate students. It brings together all the elements to be a force for climate, environmental and sustainability knowledge production.

Within its activities and the activities of its research laboratories, OVSQ has been, or still is, involved in the following programs that are of direct interest to UVSQ's contribution to EUCLEA:

"Innovative technologies for safer European coasts in a changing climate" (**THESEUS** FP7), leadership WP "Impact mitigation: resilient societies and economies";
"Improving Knowledge and Communication for Decision Making on Air Pollution and Health in Europe" (**APHEKOM**, European Commission's Programme on Community Action in the Field of Public Health funding), leading WP "Sharing Knowledge and Uncertainties with Stakeholders";
"a Transdisciplinary approach to the Emerging CHallenges of Novel technologies: Lifeworld and Imaginaries in Foresight and Ethics" (**TECHNOLIFE**, FP7) leading three WPs: "Deliberative process", "Database" and "Web portal".

Tasks assigned/Role in the project:
UVSQ will contribute to WP4 through theoretical conceptualization, methodological development and through an in depth analysis of the social dimensions of attribution/detection using heat waves in the greater Paris region (Ile-de-France) as case studies.

Short profile of key personnel involved:
Professor **Jean-Paul Vanderlinden:**
J.-P. Vanderlinden is professor of Environmental Studies and Ecological Economics at UVSQ. He is OVSQ's Associate Dean, and is leading the Environment-Science-Society research theme. Prof. Vanderlinden has extensive international experience through its involvement in FP6 and FP 7 projects, this as WP leader dealing either with Science-Policy-Integration of with the development of innovative participatory research methods. He is deeply involved in the analysis and facilitation of transdisciplinary research dynamics and as such serves as advisor to various research bodies both nationally and internationally. Before joining UVSQ in 2008, Prof. Vanderlinden was professor of Environmental Studies in Canada.

Professor **Yorghos Remwikos:**
Y. Remvikos is Professor of Environmental Health at UVSQ. He is OVSQ's co-leader of the Environmental Health research theme. After years of research on the biology of cancer, he is now devoting himself to different aspects of the relationship between environmental determinants and health, He is member of the scientific board the French research network SEnT: Health, Environment and Toxicology, financed by the Ile-de-France Region. Representing civil society in numerous regional occasions, he has also participated at the Grenelle de l'Environnement, in the work group « An environment respectful of health ». He presided over the working group on environ-mental inequalities of the Environmental Health Regional Plan for the Ile-de-France Region. Professor Remvikos has extensive international experience through partnerships in Europe and Africa. He has lead the "Sharing Knowledge and Uncertainties with Stakeholders" WP for the APHEKOM consortium.

B.2.3 Consortium as a whole

EUCLEIA brings together three National Met Services (Denmark, The Netherlands and UK) that ensure strong links to the WMO and eight Academic partners, recognised internationally as leading research centres.

The synergy present in EUCLEIA will facilitate new scientific developments that will provide the foundation of the attribution service to be realised within an operational context which regularly channels reliable attribution information to stakeholders and other users. The consortium will draw on the specialist expertise of the project partners who will each contribute building blocks of EUCLEIA that will be integrated into a reliable, well-tested, fit-for-purpose attribution service. Many members of the consortium are founder members of the Attribution of Climate-related Events (ACE) group, an informal grouping of scientists interested in developing the underpinning science needed for attribution of extreme weather and climate events.

The project includes experts in attribution science (eg IPCC Lead authors and Review Editors from Detection and Attribution chapters of IPCC; Met Office, CNRS, UEDIN, UOXF), centres involved in the production of climate monitoring products and seasonal forecasts (Met Office, IC3, KNMI), experts in seasonal to decadal prediction (Met Office, IC3, Uni Reading), expertise in climate modelling and climate process studies (Met Office, ETH, UEDIN, DMI, Uni Reading, UOXF) and expertise in social science and the dissemination of knowledge in the climate science and attribution context (HZG, UVSQ). The participants therefore span the range of expertise needed for a project of this ambition; from the underpinning scientific expertise to its application in operational climate monitoring and prediction systems, via expertise in the social science aspects of climate information dissemination.

An additional attraction of the composition of EUCLEIA is that the partner organisations are involved heavily in the development of climate services. The Met Office has been instrumental in WMO's development of the Global Framework for Climate Services (GFCS) from co-organising the First International Conference on Climate Services in October 2011 which led to the creation of the Climate Service Partnership to involvement in writing the Implementation Plan for approval by WMO Extraordinary Congress. Furthermore many of the partner organisations are involved in EU projects aimed at developing climate services, including EUPORIAS, SPECS, NACLIM, and ECOMS, a European initiative for climate service observation and modelling, which is chaired by the Met Office.

The EUCLEIA consortium has strong links with end user organisations, involved in the project's activities as international scientific collaborators and stakeholders. As well as the engagement of partner organisations with stakeholder groups through engagement in projects like EUPORIAS, the partners in EUPORIAS have garnered interest from the insurance sectors, legal and media sectors specifically with event attribution services following the stakeholder focused day at the ACE meeting in September, 2012. For example, Zurich Insurance are interested in a state-of-the-art attribution service that will improve the ability of their businesses to make effective decisions in weather sensitive sectors, and the Lighthill Risk Network has committed to work with the project to connect academic expertise, to distill industry needs and to drive practical solutions that could have a significant benefit and impact to the insurance and reinsurance industries (see letters of support in Appendix).

B.2.3.1 Subcontracting

No core tasks within EUCLEIA will be sub-contracted. The sub-contractors selected for EUCLEIA have been selected according to the rules for subcontracting laid down in the Guide to Financial Issues relating to FP7 Indirect Actions and Article II.7 of the FP7 Grant Agreement – Annex II General Conditions.

Therefore the sub-contracts described below will be awarded under conditions of transparency and equal treatment:

In order to identify the gap between the general public and the scientific community, telephone interviews among a representative segment of the regional public in (a) the greater Paris area, and (b) along the German Baltic Sea

coast, will be carried out by using commercial surveying companies (one for each region). Each region will use around 500 samples. Similar polling has been done on a similar issue for the perception of climatic threats in Hamburg since 2008 (cf. Ratter, B.M.W., K. H.I. Philipp and H. von Storch, 2012: Between hype and decline – recent trends in public perception of climate change. *Environmental Science & Policy* 18: 3 – 8).
(a) The parts of the polling activities, dealing with heat waves in the greater Paris Area, will be subcontracted by Partner 11 (UVSQ), the value of the subcontract is estimated to 12,000 Euros.
(b) Parts of the polling activities will be subcontracted by Partner 10 (HZG), the value of the subcontract is estimated to 12,000 Euros.
These activities will be carried out under WP4.

B.2.3.2 Third Party

Third party of beneficiary No 3 CNRS: Commissariat à l'énergie atomique et aux énergies alternatives (CEA). The CNRS, UVSQ and the CEA are linked to form the Joint Research Unit, Laboratoire de Sciences du Climat et de l'Environnement (LSCE). CEA is appointed as a third party (linked to this beneficiary) as staff employed by CEA will be working on the EUCLEIA project. CNRS is the appointed beneficiary of the Grant Agreement, while CEA shall be the third party linked to CNRS. Therefore Special Clause 10 is inserted into the Grant Agreement.
CEA will host the project at the joint research unit LSCE.
CEA will provide expertise from Pascal Yiou in the methodologies of attribution of extreme events.

B.2.4 Resources to be committed

The total cost of the EUCLEIA project is estimated at **4,061,706 €,** with the consortium requesting funding from the REA for **2,990,915€. Therefore 26% o**f the total budget is mobilised by the consortium via matched funds.
410 person months (PM) have been offered to the project from the 11 partners.

B.2.4.1 Financial Planning for the Project

The majority of the funding for EUCLEIA is required for personnel costs, as the project will be relying on the skills and many years of expertise of the partner organisations involved. Therefore it was key that the budget was calculated using an estimation of costs associated with the experts identified to deliver the project's objectives, and their role within the project. Thus, as the tasks and description of the work packages developed; the associated estimate of personnel resources developed. This iterative approach to calculating the required budget to deliver the work packages and the project as a whole will ensure a good estimate of the resources required, and associated funding required.
Partners were asked to estimate their own travel budget and other costs required. These requests were then challenged and compared to ensure consistency. When considering the travel required in this project, all partners and stakeholders will, as best practise, avoid unnecessary travel, and use alternative forms of communication (such as teleconference, Skype).

B.2.4.2 Distribution and Breakdown of Resources

2.4.2.1 Personnel Costs

Direct costs for personnel amount to 51% of the total project budget. A proportion of this is used to develop stakeholder engagement and to understand the interests of scientist's versus public interests. Activity will be undertaken in two regions to ensure a good geographical spread and to make sure that EUCLEIA is capturing the requirements from areas with different lifestyles.

2.4.2.2 Management and Other Costs

163,076**€** (5.4%) of the total project budget will be used for the core project management activities (WP1 and WP2) [described in Section B.2.1]. The personnel costs will cover the Coordinator, a Project Manager, Science Coordinator and Project Administrator.

2.4.2.3 Other Direct Costs

250,472**€** of the total budget has been put aside for other direct costs (non-personnel costs). These costs are primarily associated with travel and workshops.

It is difficult to predict the exact nature of the travel requirements for dissemination/ conferences. Therefore EUCEIA partners have included all travel requirements under the RTD Activity.
Table 2.4.2 provides a breakdown per partner of these other direct costs.

Table 2.4.2: Summary of Other Direct Costs

Partner	Description of Cost	Value € (total budget) excluding overheads (indirect Costs)	Deliverable	Activity (i.e.RTD)
1 Met Office	Travel and Subsistence costs for Met Office staff to attend General Assemblies, work package coordination meetings and stakeholder workshops: 3 people attending each GA; Science coordinator attending 5 WP meetings; 2 people attending 2 stakeholder workshops	10,000	WP2	RTD
1 Met Office	Travel and subsistence costs for the Science Advisory Board: 3 members of the board attend each of the General Assemblies	10,800	WP2	RTD
1 Met Office	Cost of hosting workshops, stakeholder travel costs, conference travel and publication fees: T&S for stakeholders (20,000); host workshop (500); conference travel (4,100); publication fees (2,500)	27,100	WP3	OTHER
1 Met Office	Travel and subsistence for Coordinator to attend coordination meetings	1,850	WP9	OTHER
2 ETH	Travel and subsistence	15,000	WP6,7	RTD
3 CNRS	Travel and subsistence	15,000, of which 7,500 can be allocated to CEA	WP5,6,7,8	RTD
4 UEDIN	Travel and Subsistence for PDRA (attend meetings, and visit rest of project once)	6,000	WP6	RTD
4 UEDIN	Travel and Subsistence	8,400	WP6	RTD
4 UEDIN	Publication of two scientific papers	3,000	WP6	RTD
4 UEDIN	Computing, data processing, storage, software licenses	12,000	WP6	RTD
5 IC3	Travel and subsistence	15,000	WP6,7,8	RTD
6 DMI	Travel and subsistence	15,000	WP6,7	RTD
7 KNMI	Travel and subsistence	15,000	WP5,6,7,8	RTD
7 KNMI	Publication charges	2,500	WP5,6,7,8	RTD
8 Uni Reading	Travel and Subsistence to project meetings	10,640	WP5,6,7	RTD
8 Uni Reading	Server costs, High Performance Computing (HPC) Contribution, computing budget for PDRA	8,177	WP5,6,7	RTD
8 Uni Reading	Journal publication charges	4,200	WP5,6,7	RTD
9 UOXF	Travel and Subsistence	14,167	WP4,5,7	RTD
9 UOXF	Provision of high specification computers for PDRAs – necessary tools*	11,200	WP4,5,7	RTD
9 UOXF	Stakeholder engagement activities, including workshops, webinars, printing eLearning resources	14,638	WP4,5,7	RTD
10 HZG	Travel and Subsistence	14,800	WP4,7	RTD
11 UVSQ	Travel and Subsistence for attending project meetings and associated conferences	16,000	WP4	RTD

*: Requirement is for very high specification computers as essential tools to undertake work in EUCLEIA. Department at Oxford does not provide new PCs (or PCs of the standard needed here) from departmental funds.

2.4.2.4 Sub-contracting

Subcontracts are only planned for non-core tasks.The sub-contracts are detailed in Table 2.4.3 below. These are primarily for the audits required. KNMI state that the costs of external audit will not be charged to the project as they make use of their own government auditors.

Table 2.4.3: Sub-contracting Breakdown

Partner	**Description of sub-contract**	**Value € (total budget)**	**Deliverable/ Activity**
1 Met Office	Audit	3,000	MGT
10 HZG	Survey costs	12,000	WP4 (RTD)
11 UVSQ	Survey costs in association with phone and street surveys	12,000	WP4

2.4.3 Resources that will complement the EU contribution

The following contributions to EUCLEIA are 'in kind' and will therefore enhance the offering of the project:

- Considerable involvement during the full duration of the project by numerous stakeholders from across the EU countries.
- Links with ACE
- Opportunities for publishing the findings of the project through the BAMS newsletter.
- Academic Publications undertaken by partners.

B.3 Potential Impact

B.3.1 Strategic impact

B.3.1.1 Expected impacts

1. Better understanding of current climate and weather-related risks
2. Improved credibility of climate services by the development of reliable attribution products placing recent weather and climate events in the context of climate variability and change
3. Improved business continuity and resilience of society to extreme weather and climate events
4. Improved climate change adaptation strategies for commercial activities and policy initiatives
5. Contribution to the World Meteorological Organisation (WMO) Global Framework for Climate Services

The main outcome of EUCLEIA will be the development and delivery of authoritative, reliable and regular assessments of the contribution of natural and anthropogenic factors to recent weather and climate events in Europe.

This contribution requires a European, rather than a national or local, approach, because by pooling European expertise it becomes possible to develop a world-leading quasi-operational attribution system for Europe. This will improve the ability of European citizens and businesses to deal with weather and climate risks. By bringing together the relevant expertise from across Europe, and by seeking to understand a variety of European stakeholder perspectives for attribution services, the aim of EUCLEIA is to contribute strongly to the development of European climate change adaptation strategies for both commercial and policy sectors. EUCLEIA will also engage with European citizens so that they better understand climate risks and the ability of attribution science to elucidate them.

Attribution assessments will focus on five types of weather event associated with substantial impacts in Europe: heatwaves, cold spells, floods, droughts and storm surges. EUCLEIA will concentrate on the European region but will collaborate with scientific collaborators in other continents thereby enabling advances made in the science of event attribution in Europe to influence international partners in their development of attribution services for other regions.

It will allow stakeholders to understand how anthropogenic climate change and natural variability has contributed to the occurrence of recent extreme weather and climate events, thereby enabling stakeholders to better adapt to such events. Currently there can be a lot of speculative, confusing, and contradictory information about the links to climate change following extreme weather events. Misattribution, incorrectly attributing a particular weather event to anthropogenic or natural causes, could lead to poor adaptation decisions. On the other hand reliable information on the extent to which a particular class of extreme weather event in a particular location is becoming more or less likely under anthropogenic climate change is of great potential value to informing adaptation decisions and to directing adaptation funding appropriately.

EUCLEIA has been structured to maximise the impact of the research carried out in the proposal. A user panel representing the requirements of key sectors will be engaged throughout the project to ensure that the research is steered to develop useful products. Furthermore, WP4 includes a detailed study of stakeholders in two particular regions in order to enable an in depth analysis of the potential of attribution services to meet very specific user needs. In addition, there is a research strand in WP4 aiming to better understand public perception of attribution science and thereby develop improved protocols for public engagement, and there is an important training and outreach element envisaged, to enable the scientific knowledge gained in EUCLEIA to be widely disseminated to the academic research community and the wider public. Finally an Advisory Board will be constituted (see Section B.2), made up of distinguished experts in the field of monitoring, attribution and seasonal forecasting for the development of climate services. The Advisory Board will provide independent advice and recommendations to the project to guide it in achieving its aims.

A crucial aspect of EUCLEIA is the development of a quasi-operational attribution system (WP8) in close partnership with EUCLEIA stakeholders. The in depth nature of the engagement envisaged by EUCLEIA in the development of such an attribution system will lay the essential groundwork for attribution products to be fully

embedded in future climate services. This will require well understood pre-defined methodologies, a sophisticated understanding of the application of such products in key sectors, and a capability to produce scientifically robust assessments on a regular and time-bound basis. Building these key elements into the project will enable EUCLEIA to contribute substantially towards the development of operational climate services in the climate change context of Copernicus.

There are two particular areas where synergy and non-duplication with other 2013 FP7 Space Call projects (see also WP9) will be ensured. WP6, ("Observations for key climate processes: collection and identification of needs") Task 6.1, will not produce new data sets but will use already existing data sets for evaluating models and developing reliability assessments, and for interpreting extreme events, in particular by using observations (in situ or remote sensed), and reanalyses, together with model sensitivity experiments in order to better understand and diagnose the mechanisms involved. There will be an effort within WP6 to ensure that any relevant results are incorporated from the observationally based project Q4ECV and it will be interesting to liaise with CLIPC regarding the potential for comparing past observed events with projections of future such events. There will also be effort within WP5 ("Development of attribution methodologies and exploration of framing issues") to ensure that relevant developments from the two reanalysis projects ERA-CLIM2 and UERRA are incorporated into the project. In particular WP6 will compare RCM simulations of the past 50 years with both global and regional reanalyses under the ERA-CLIM2 and UERRA projects to enable detailed validation of the physics parametrisations and structural assumptions of the RCM used for event attribution and identify event classes for which the simulations are sufficiently realistic to permit attribution statements to be made. New reanalysis products will also be used to evaluate the reliability of event attribution systems.

B.3.1.2 Other national and international research activities

Development of Attribution science and Attribution Services
While the development of a quasi-operational attribution system for Europe requires a European approach, the work of EUCLEIA is well aligned with international research activities in the field of attribution science and the development of methodologies to attribute individual weather and climate events. We have assembled a strong team of international collaborators who are members of the IDAG group, an internationally respected group of attribution scientists (IDAG, 2005; Stott et al, 2010). EUCLEIA partners are founder members of the international Attribution of Climate-related Events (ACE) group, with the Scientific Steering Committee of the recent ACE meeting in Oxford being chaired by the EUCLEIA coordinator.

Development of Observations and Monitoring
EUCLEIA have active links to a number of European and international activities including leadership and membership of EURO4M and ECA&D in Europe, and membership of ISTI and the ETCCDI internationally.

Contribution to the WMO GFCS
The Met Office has strong links to the WMO GFCS through membership of the WMO Task Teams engaged in developing the GFCS implementation plan (Hewitt et al, 2012) and with the Met Office being a WMO Global Producing Centre for long range forecasts.

WCRP, IPCC
The coordinator of EUCLEIA led a position paper to the WCRP Open Science Conference in Denver, 2011, which is also co-authored by other EUCLEIA partners, and which sets out the case for development of event attribution systems and discusses the challenges involved in developing systems to provide regularly updated and reliable attribution assessments of unusual or extreme weather and climate-related events (Stott et al, 2012). One of the EUCLEIA partners (IC3) is a member of the WCRP Working Group on Seasonal to Interannual Prediction which is co-chaired by the Met Office. The EUCLEIA coordinator is a Coordinating Lead Author of the chapter on Detection and Attribution of Climate Change in Working Group I of the 5th Assessment Report of the IPCC and other EUCELEIA partners are coordinating lead authors, lead authors and review editors of others chapters in WGI (Met Office, CNRS, KNMI, Edinburgh, Reading, Oxford), and EUCLEIA partners also include a core writing team member of the AR5 synthesis report (Edinburgh), and a lead author of WGII (HZG). In addition ETH lead investigator was a CLA of the IPCC SREX report.

Other Copernicus projects

Links will be made with the other Copernicus projects, EUPORIAS, SPECS, NACLIM and ECOMS, the latter being a think tank, whose activities are targeted at producing specific papers for the European Commission related to "Observations and monitoring", "Modeling and infrastructure". and "User/stakeholder engagement". The three coordinators of NACLIM, EUPORIAS and SPECS (Chris Hewitt -Chair-, Francisco Doblas-Reyes, Detlef Quadfasel) are the members of the ECOMS board and consequently having one of the coordinartors as a PI of EUCLEIA (Doblas-Reyes) and having the chair of ECOMS at the Met Office, will enable easy links to be made in such a way that lessons can be shared concerning managing Europe's ability to effectively prepare for and manage climate-related risk on our society. We will also link with the ESA CCI, which will be faciliated by having the CMUG component of the CCI based at the Met Office. At the start of the project we will contact the project coordinator of the FP7 Aeronautics Support Action 'WEZARD: Weather Hazards in Aviation' (www.wezard.eu) in order to understand what lessons this project can offer to EUCLEIA. WEZARD brings together initiatives integrating spaceborne, airborne and ground-based sytems, for e.g. in relation to volcanic ash, icing and other weather hazards.

B.3.2 Plan for the use and dissemination of foreground

B.3.2.1 Dissemination and exploitation of the results

Measures proposed for dissemination

EUCLEIA has a number of means for disseminating and exploiting results. The continued engagement with the stakeholder community during the course of the project will be a key factor to the success of identifying deliverables that can be used by a range of sectors. The community comprises of four groups: the stakeholders defined in WP4 including regional managers, the general public, a stakeholder "user panel", and the scientific research community, where each group can be supported through specific engagement and communication activities.

Regional managers

WP4 is explicitly devoted to stakeholder engagement with a particular focus on regional managers, the insurance industry and the general public. WP4 will involve, from a social science perspective, an in-depth component to stakeholder engagement by investigating in detail stakeholder requirements for dealing with the impacts of heatwaves on public health in the Paris area and in dealing with the threat of storm surges along the German Baltic sea coast. Both partners, HZG and UVSQ, have developed good working relationships with regional and municipal authorities and other stakeholders in the two regions. As an example of this existing level of engagement, a survey of non-scientific users of scientific knowledge has already been conducted; "A survey of the perceptions of regional political decision makers concerning climate change and adaptation in the German Baltic Sea region" Bray and Martinez, 2011). The survey sample consisted of two groups of individuals. The first group (constituting the overwhelming majority of those targeted) consisted of the heads of local governments in the German states of Schleswig-Holstein and Mecklenburg- Vorpommern. The local governments targeted included cities, *Gemeinden* (municipalities) and *Ämter* (larger administrative divisions consisting of multiple *Gemeinden* and/or cities). Only those local governments located within the Baltic Sea drainage basin were targeted. The individuals targeted typically held the position of *Bürgermeister* (mayor) or *Amtsvorsteher* (superintendent of an *Amt*). These positions provide a survey sample of political stakeholders operating at a local level, while still possessing sufficiently significant decision-making power.

Stakeholder User Panel

A EUCLEIA stakeholder user panel will be constituted of representatives of key sectors including insurance, the legal sector and the water industry, who will meet regularly throughout the project to help guide the research to ensure its relevance from a stakeholder perspective. This engagement will be built on the successful ACE meeting held in Oxford in September, 2012, which included a very successful stakeholder day (see letter of support). Face-to-face workshops will be used throughout the project to allow the user panel and the scientists to openly discuss issues associated with the project and to inform the next phase, in a manner that facilitates genuine dialogue. It is envisaged to hold these workshops at the following milestones: six months, 18 months (start of WP7), and 34 months (end of the project). At the mid-point meeting (month 18) we will draw together the requirements identified from WP4 (Tasks 4.1 and 4.2) and from the stakeholder meeting, thereby ensuring consideration of broader end-user needs, and use them to inform the development of WP7 (Application of the methods to targeted test cases)

which starts at month 18 and WP8 (Development and application of a near-real time attribution service). The mid project stakeholder meeting will also be informed by the conclusions drawn at that stage from WP5 (Development of attribution systems including methodology and framing), WP6 (Evaluation and diagnostics) and WP8 regarding technical feasibility and will therefore be in a position to make suitable recommendations for the development of near-real time attribution service to deliver attribution products on a regular basis under WP8.

In addition to the workshops, the user panel will be engaged with the research findings through webinars (quarterly) and an eNews letter (monthly). It is seen that there will be an opportunity to develop a dialogue through the webinars, although from experience, the technology does not allow the freedom of thought and discussion that face-to-face workshops have.

General Public

There will be a range of outreach to the general public through the dissemination of key scientific results, and through learning activities on attribution science. There will also be specific training modules aimed at early career researchers to increase the capacity within Europe of scientists to develop the understanding and application of attribution science.

WP4 will also poll the general public to identify gaps between the perceptions of the public and the scientific community concerning attribution, and WP4 will study the interests and views held by representatives of the insurance and re-insurance industries.

The continuing engagement with the public is an important aspect of EUCLEIA. As well as being able to inform the wider public of the ongoing results, the engagement process will be able to address the knowledge gaps identified in WP4. Because of the dispersed nature of the population, it would be necessary to deliver this through online resources. Pedagogically robust, digital learning resources will be developed to support understanding of key concepts and ideas crucial to understanding attribution science. Examples of these digital resources include: audio and video podcasts, blogs, briefing papers, discussion forums and webinars. An important part of the public engagement process is providing them with an opportunity to ask questions of the scientists and develop a dialogue that will allow them to deepen their understanding through being able to contextualise the science. These resources can be used in isolation by training providers or as part of a coherent package that guides the learner in understanding a specific aspect of the science. The online courses will be maintained through a publically accessible managed learning environment, such as moodle, and through social networking sites, e.g. YouTube.

Dissemination through the broader media (radio, newspapers and television) will also allow the results of EUCLEIA to reach a pan-European public audience. This process will be facilitated through the use of press releases and interviews.

Scientific community

Scientists on the project will contribute to professional development courses by collaborating on existing and proposed summer schools where there are attribution components, e.g. the NCAS and NCCR summer schools.

Dissemination of research activities and results to academic audiences will enable EUCLEIA to inform the wider attribution science community of key findings. Such dissemination activities will include: the publishing of academic papers in high impact journals; contributing to the Bulletin of the American Meteorological Society annual attribution report; attending international conferences and workshops, such as EGU and the annual meetings of the IDAG and ACE groups.

Project website

A central project website will be created to coordinate internal communication and to facilitate external dissemination of information and results. It is increasingly being recognised that stakeholders are no longer content with being provided with a ‘portal’ of tools and resources, but rather they need guidance information to support their use and application. To this end, the website will not only communicate the results and ‘quasi-operational’ tools, but also include detailed information on how they can be used in the decision-making process and what other

attribution science and understanding would be applicable. This central website will host the eLearning resources and act as a central point of information for further details following press releases.

Engagement with development of Climate Services
The Met Office is taking a leading role in the development of Climate Services with Met Office leading EUPORIA and with Dr Chris Hewitt of the Met Office being chair of ECOMS, a European initiative for climate service observation and modelling, which consists of the NACLIM, SPECS and EUPORIAS projects. If successful we would seek to supplement our close internal project collaboration with seasonal forecasting with involvement in the ECOMS group, in order to support the development of information to aid society to prepare for, and manage, climate-related risks.

B3.2.2 Exploitation of results and measures proposed to increase the likelihood of market uptake of project results

We will demonstrate the feasibility and utility of attribution products through the development of a quasi-operational attribution system. Two WPs test out the capability of the attribution system developed under EUCLEIA against actual climate events. WP7 tests out the capabilities on a set of targeted test cases, while WP8 runs the quasi-operational system for a year producing regular results.
One delivery mechanism for outputs of the quasi-operational system is to publish reports in the annual BAMS attribution report and this provides an excellent opportunity both to establish the scientific credentials of these results but also to disseminate them to a wide scientific audience and via publicity materials and press releases to a wide public audience (the first BAMS attribution report published in July 2012 attracted considerable media attention). We will also work closely with the user panel and the stakeholders identified in WP4 to establish the utility of the attribution assessments produced and to determine the potential for market uptake of such attribution results by the insurance and legal sectors. Based on the experiences gained, Task 8.4 provides a report on lessons learned and recommendations for further development of operational attribution systems.

Contribution to the growth of the Copernicus downstream service sector
We will involve downstream climate service providers through the stakeholder engagement identified in WP3 and WP4. This will contribute to the development of commercial activities in this field by developing the research needed to generate attribution products of interest and relevance to downstream climate service providers in the commercial sector, although we will also seek to engage with stakeholders in the public sector.

B.3.2.3 Management of Intellectual Property

The Consortium partners in the EUCLEIA project appreciate that properly managing intellectual property used and generated during the project shall be key to its overall success. The Partners shall adopt a strategy that encapsulates the guiding principles of FP7 and a suite of management protocols to deliver the objectives within that strategy. Furthermore, everything agreed by the partners will be consistent with the General Conditions of the FP7 Grant Agreements dealing with Intellectual Property. The SIMG will oversee compliance and ensure the protocols are fully integrated within all the activities undertaken by the project. The overall aim will be to maximise all developed intellectual property to its fullest extent to achieve maximum benefit for and on behalf of the stakeholders.
The Management Board will be the owner and the SIMG will be the Steward of all foreground intellectual property. The SIMG will identify foreground intellectual property, protect it in line with the partners' protocols and, thereafter, steward its future use. The SIMG will deal with all contentious issues that may arise during the lifetime of the project.
Background intellectual property will be catalogued and distributed under licenses to the partners who require it for use or development. Derived intellectual property will be handled in accordance with the agreements reached by the partners. Each of the partners will have the right to exclude specific pre-existing know-how from the other partners access, as far as the restrictions are announced before the signature of the funding contract or before the effective joining of a new partner. The procedure to handle these cases will be settled in the Consortium Agreement.

Foreground intellectual property will be identified at the point of creation and steps taken to ensure its protection. Partners will respect their individual Intellectual Property Rights. In the event of an invention being the work of a single partner of the project and solely the result of individual intrinsic skills rather than shared knowledge, this partner will be the exclusive owner of the results, subject to granting access rights to the other partners where necessary for their execution of the project or to the use of their own results. The conditions will be fixed in the Consortium Agreement. For the case in which the designated owner of the results waives its option to start registration proceedings the SIMG will follow a procedure outlined in the Consortium Agreement to allow other project partners the opportunity to obtain or maintain such protection. All foreground Intellectual Property will be catalogued and made available under license. Interdependencies will be noted and cross referenced for ease of future use. Protocols will permit the use of background and foreground intellectual property together where interoperability is crucial to its optimised use.
The SIMG will be tasked with dissemination of foreground intellectual property, having due regard to the legitimate interest of each beneficial partner. The partners will provide unfettered access to as much of the foreground intellectual property where legitimate interests are not compromised. At all times the requirement of the FP7 Grant Agreement will be the minimum standard for the project to work under. All published work will contain reference to the research funding leading to the results.

Access rights will be considered on a case by case basis and where appropriate after consultation with the partners concerned. The aim will be that data produced by EUCLEIA will be freely available on the research pages of the EUCLEIA website. Note that where data input to EUCLEIA is subject to data agreements (for example for raw observational data only being available for research use, or, as can be the case for some high time resolution meteorological data from some regions of the world, not available at all without payment of commercial rates) then we would need to refer users of derived products back to the original data providers if they wish to obtain data that were part of the productions of such EUCLEIA attribution products.

All records will be maintained electronically, both locally and centrally (by the SIMG), providing reconcilable audit trails for the REA.
IPR awareness training can be given for personnel working on the project; and the partners' legal teams will be engaged to provide support and advice on IPR matters.

B.4 Ethics Issues

Not Applicable.

B.5 Consideration of Gender Aspects

Approximately 27% of the scientists named by the partners as working on EUCLEIA are female. Two out of the eight WP leaders and co-leaders are female. This is a not particularly high proportion, but does indicate that females are an integral part of the EUCLEIA project.

The Consortium is aware of the importance of attracting more high quality female researchers into the sphere of scientific research. EUCLEIA will ensure it acts upon the EC recommendation through the FP7 'Science in Society Programme' to stimulate young people to take on science studies, and promote the progress of women in scientific careers. (http://ec.europa.eu/research/fp7/index_en.cfm?pg=society: FP7 'Science in Society' Programme). EUCLEIA will support equal participation between men and women within all activities of the project; whilst complying with legislation concerning gender equality. Although no gender issues relating to subject matter are expected in connection with this work, actions will be undertaken during the course of the project to promote and ensure gender equality in EUCLEIA.

B.5.1 Present Consideration of Gender Aspects by the Consortium

Many of the partners in EUCLEIA have gender action plans at the institutional level as part of their commitment to gender equality. These include programmes to raise awareness of the issues involved in gender equality, commitments to family friendly work practices and career breaks, and provision of child-care facilities. Organisational initiatives to encourage gender equality have high-level support within partner institutes. For example, the Met Office has an ongoing equality training programme, co-ordinated at Executive level, which is mandatory for all staff. In fact, the number of female employees at the Met Office has increased from 22% in 2007 to 28.9% in 2012.

B.5.2 Management of Gender Aspects

The promotion and monitoring of gender equality throughout the project will be the responsibility of the SIMG (see Section 2.1), through a specifically created project Gender Aspects Management Team. One of the first actions of the Team will be to produce a Gender Action Plan (GAP), which will be fully communicated to partners. The Team will be responsible for ensuring the GAP is applied throughout the project, and that a process is followed for monitoring gender equality. The GAP will encompass both internal and external participants, stakeholders and those involved in surveys and trials.

The Gender Action Plan will:

- Encourage recruitment of women at equal scientific merit; all job advertisement will state the project's commitment to equality and to a family-friendly working environment;
- Help the participation of women/working parents by utilising modes of communication that do not involve the necessity to travel (i.e. e-conferencing);
- Ensure all partners encourage flexibility in the working hours of individuals involved in project;
- Ensure all the consortium are aware of EU gender legislation, including advertising gender equality on internal websites.

The SIMG will encourage all partners to promote training opportunities to their project participants (for example, the EC Research DG conducts training on understanding the gender aspects within scientists' research fields). An Annual Gender Action report will be produced by the Project Manager which will detail the extent to which actions promoting gender equality have been performed, and the levels of gender participation at all levels of the project, including the Management Board level.

APPENDICES

Appendix 1: References

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Appendix 2: Glossary of Terms/Acronyms

A

ABI: Association of **B**ritish **I**nsurers
ACE: Attribution of **C**limate-related **E**vents
AMOC: Atlantic **M**eridional **O**verturning **C**irculation
AMS: American Meteorological Society
ANR: French National Research Agency
APHEKOM: EU funded project on Improving Knowledge and Communication for Decision Making on Air Pollution and Health in Europe
AR5: IPCC Assessment Report 5
ATOPICA: FP7 project on atopic diseases in changing climate, land use & air quality

B

BACC: BALTEX assessment of climate change for the Baltic Sea basin
BALTEX: an interdisciplinary research network for the Baltic Sea region
BAMS: Bulletin of the **A**merican **M**eteorological **S**ociety

C

C20C: The climate of the 20th century project
CCI: Climate **C**hange **I**nitiative
CEA: Commissariat à l'**E**nergie **A**tomique
CFU: Climate **F**orecasting **U**nit
CICS: Cooperative **I**nstitute for **C**limate and **S**atellites
Climate-KiC: Knowledge **I**ntegration **C**ommunity that connects global and local, small and large partners from the private, public and academic sectors
CLIMRUN: Climate **L**ocal **I**nformation in the **M**editerranean region: **R**esponding to **U**ser **N**eeds
CMIP5: **C**oupled **M**odel **I**ntercomparison **P**roject, Phase **5**
CNRS: Centre **N**ational de la **R**echerche **S**cientifique; project partner
COMBINE: FP7 project on the Comprehensive Modelling of the Earth System for Better Climate Prediction and Projection
COPERNICUS: The European Earth Observation Programme, previously known as GMES
CORDEX: **CO**ordinated **R**egional climate **D**ownscaling **E**xperiment, WCRP-sponsored program
COSMO: DWD operational regional numerical weather forecasting model (**CO**nsortium for **S**mall-scale **MO**delling)
COSMO-CLM: Regional climate model based on COSMO
CSP: **C**limate **S**ervices **P**artnership

D

DEM: Demonstration
DENFREE: FP7 Project on **DEN**gue research **F**ramework for **R**esisting **E**pidemics in **E**urope
DG: Directorate **G**eneral
DROUGHT-CH: An FP7 project on the early recognition of critical drought and low flow in Switzerland
DROUGHT-R&SPI: Fostering European Drought Research and Science-Policy Interfacing
DWD: Deutcher Wetterdienst, German Weather Service

E

EC: European **C**ommission
ECA&D: European **C**limate **A**ssessment & **D**ataset project
EC-Earth: a European Earth System model based on ECMWF modelling systems
ECMWF: European **C**entre for **M**edium-Range **W**eather **F**orecasts
ECOMS: A European initiative for climate service observation and modelling

EMBRACE: FP7 project on **Earth system model bias reduction and assessing abrupt climate change**
ENSEMBLES: EU FP6 project
ERA-CLIM: European Reanalysis of Global Climate Observations project
ERC: European **R**esearch **C**ouncil
ES: Earth **S**ystem
ESM: Earth **S**ystem **M**odel
ESA: European **S**pace **A**gency
ETH: Eidgenössische **T**echnische **H**ochschule Zürich, Swiss Federal Institute of Technology; project partner
EU: European **U**nion
EUCLEIA: EUropean, **CL**imate and weather **E**vents: **I**nterpretation and **A**ttribution
EUCLIPSE: **E**uropean **U**nion **C**loud **I**ntercomparison, **P**rocess **S**tudy & **E**valuation Project
EUPORIAS: EUropean **P**rovision **O**f **R**egional **I**mpact **A**ssessment on a **S**easonal-to-decadal Timescale
EURO4M: European Reanalysis and Observations for Monitoring project.
EuroSIP: European Seasonal-to-Interannual Prediction

F

FAR: Fraction of **A**ttributable **R**isk
FORSA: a commercial German surveying company
FP: Framework **P**rogramme
4DVAR: Four-dimensional variational data assimilation
FP: Framework **P**rogramme

G

GAP: Gender **A**ction **P**lan
GCM: General **C**irculation **M**odel
GEOLAND: GMES (now COPERNICUS) Land Monitoring Service
GEWEX: Global Energy and Water Cycle Experiment
GFCS: Global **F**ramework for **C**limate **S**ervices
GLASS: Global **L**and/**A**tmosphere **S**ystem **S**tudy
GMES: EU-led initiative - **G**lobal **M**onitoring for **E**nvironment and **S**ecurity, now called COPERNICUS
GPC: Global **P**roducing **C**entre (for long-range forecasts)

H

HadAM3: The atmospheric component of the Hadley Centre Coupled Model HadCM3
HadGEM: Hadley **C**entre **G**lobal **E**nvironmental **M**odel
HadISST: Hadley Centre **S**ea **I**ce and **S**ea **S**urface **T**emperature data set
HadRM: The Hadley Centre regional model
HCCP: Met Office **H**adley **C**entre **C**limate **P**rogramme
HiGEM: High Resolution **G**lobal **E**nvironmental **M**odelling
HZG: Helmholtz-**Z**entrum **G**eesthacht (Centre for Materials and Coastal Research); project partner.

I

IC3: Catalan Institute of Climate Sciences; project partner
ICE 2 SEA: FP7 project on estimating the future contribution of continental ice to sea-level rise
IDAG: The **I**nternational Ad Hoc **D**etection and **A**ttribution **G**roup
IfK: German Institute for Coastal Research
iLEAPS: Integrated **L**and **E**cosystem-**A**tmosphere **P**rocesses **S**tudy
IMPACT2C: FP7 project on quantifying projected impacts under 2^0C warming
IPCC: Intergovernmental **P**anel on **C**limate **C**hange
IPR: Intellectual Property Rights
IPSL-CM: Institut **P**ierre **S**imon **L**aplace **C**limate **M**odel

K

KNMI: **K**oninklijk **N**ederlands **M**eteorologisch **I**nstituut; project partner
KPP: K-Profile **P**arametrization

L

LBNL: Lawrence Berkeley National Laboratory
LSCE: Laboratoire des **S**ciences du **C**limat et de l'**E**nvironment

M

MGT: Management
MOHC: Met Office Hadley Centre

N

NACLIM: FP7 project on the North Atlantic climate
NCAS: National **C**entre for **A**tmospheric **S**cience
NCDC: National **C**limatic **D**ata **C**enter
NCEO: National **C**entre for **E**arth **O**bservation
NERC: Natural **E**nvironment **R**esearch **C**ouncil (UK)
NIES: Japanese **N**ational **I**nstitute for **E**nvironmental **S**tudies
NIWA: New Zealand provider of atmospheric and aquatic science and associated commercial services
NOAA: National **O**ceanic and **A**tmospheric **A**dministration
NRT: Near **R**eal **T**ime

O

OeRC: Oxford **e-R**esearch **C**entre
OMI: Ozone **M**onitoring **I**nstrument
OVSQ: Observatoire de **V**ersailles and **S**aint-**Q**uentin-en-Yvelines

P

PCIC: Pacific **C**limate **I**mpacts **C**onsortium
PDRA: Post-**D**octoral **R**esearch **A**ssistant
PI: Principal **I**nvestigator
PM: Person **M**onths
PMIP: Paleoclimate **M**odel **I**ntecomparison **P**roject
PREDICATE: Mechanisms and Predictability of Decadal Fluctuations in Atlantic-European Climate Project
PRINCE2: Projects **IN C**ontrolled **E**nvironments

Q

QWeCI: FP 7 project on Quantifying Weather and Climate Impacts on Health in Developing Countries

R

RACMO: Regional **A**tmospheric **C**limate **Mo**del
RADOST: Regional Adaptation Strategies for the German Baltic Sea Coast
RAPID: NERC project on the causes of rapid climate change with a main focus on the role of the Atlantic Ocean thermohaline circulation
RAPID-WATCH: NERC project on Monitoring the Atlantic Meridional Overturning Circulation
RCC: Regional **C**limate **C**entre
RCM: Regional **C**limate **M**odel
REA: Research **E**xecutive **A**gency
RTD: Research and **T**echnological **D**evelopment

S

SIMG: Special Interests Management Group
SNF: Swiss National Science Foundation
SOC: State **o**f the **C**limate (BAMS annual report)
SOGE: School of Geography and the Environment, University of Oxford
SPECS: Seasonal-to-decadal climate Prediction for the improvement of European Climate Services
SREX: Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation
SACA&D: Southeast **A**sian **C**limate **A**ssessment **& D**ataset
SST: Sea **S**urface **T**emperature
SSTSI: Sea **S**urface **T**emperature and **S**ea-**I**ce

T

TEA-COSI: The **E**nvironment of the **A**rctic: **C**limate, **O**cean and **S**ea **I**ce
TECHNOLIFE: FP7 project on a **T**ransdisciplinary approach to the **E**merging **CH**allenges of **NO**vel technologies: **L**ifeworld and **I**maginaries in **F**oresight and **E**thics
TEMPEST: NERC Project on **T**esting and **E**valuating **M**odel **P**redictions of **E**uropean **ST**orms
THESEUS: Innovative technologies for safer European coasts in a changing climate project
THOR: FP7 Project **TH**ermohaline **O**verturning – at **R**isk**?**
TROPOMI: TROPOspheric **M**onitoring **I**nstrument

U

UEDIN: University of **Edin**burgh; project partner
UK: United **K**ingdom
UNFCCC: United **N**ations **F**ramework **C**onvention on **C**limate **C**hange
UOXF: University of **Oxf**ord, project partner
USA: United **S**tates of **A**merica
UVSQ: Université de **V**ersailles **S**aint-**Q**uentin-en-Yvelines; project partner

V

VALOR: VALue **O**f the **R**APID (Assessing the value of monitoring the AMOC)

W

WACMOS: Water **C**ycle **M**ultimission **O**bservation **S**trategy
WCRP: World **C**limate **R**esearch **P**rogramme
WMO: World **M**eteorological **O**rganisation
WP: Work **P**ackage
WRF: Weather **R**esearch and **F**orecasting Model
WWRP: World **W**eather **R**esearch **P**rogramme

Appendix 3: Letters of support to EUCLEIA

International Scientific Collaborators

1. NOAA's National Climatic Data Center (NCDC), the Cooperative Institute for Climate and Satellites (CICS) and the editor of the Bulleting of the American Meteorological Society State of the Climate Report

2. Lawrence Berkeley National Laboratory (LBLN)

3. National Institute of Environmental Studies (NIES), Japan

4. ARC Centre of Excellence for Climate System Science, Australia

5. National Institute of Water and Atmospheric Research (NIWA), New Zealand

6. Environment Canada

7. Pacific Climate Impacts Consortium, Canada

6. The International Ad Hoc Detection and Attribution Group (IDAG)

Stakeholders

1. The Lighthill Risk Network (LRN)

2. Zurich Insurance Group

3. Munich RE

4. Risk Prediction Initiative (RPI)

5. University of Houston Law Center

6. BfG, German Federal Institute of Hydrology